ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLV. No. 6. NEW YORK, SATURDAY, AUGUST 6, 1904. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: 40 Dearborn Street, Chicago, Ill. LUCIEN W. MARSHALL, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each 25

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

CONTENTS.

EDITORIAL:
The Battle of the Powers . . . 181
Legislative Policies . . . 181
The Electrical Generation of Steam . . . 182
Shall Interurban Electric Roads Be Given Subsidies? . . . 183
Electrical Transmission Electrostatically Treated, by J. Stanley Richmond . . . 183
Excellent Performance of a Reciprocating Engine . . . 184
Railroad School for Telegraphers . . . 184
Some Points in a Comparison of Types of Railway Motors . . . 185
The Palermo-Monreale (Italy) Incline System, by C. L. Durand . . . 187
Operation of Synchronous Converters, by S. C. Lindsay . . . 190
Boiler House Economies, by Reginald S. Downe . . . 192
The Opportunities for Electrical Household Utensils . . . 195
The Simmance-Abady Photometer . . . 196
New Michigan Electrical Society . . . 197
Wave-Operated Clocks . . . 197
A Means for Retaining Armature Coils . . . 197
Model Library at the Fair . . . 197
The Telephone Situation in London . . . 197
The New Headquarters of the Police Telegraph of the Borough of Brooklyn . . . 198
Ohio Electric Light Association . . . 200
Old Time Telegraphers and Military Telegraph Corps . . . 200
Technical Newspaper Men Inspect Rapid Transit Subway . . . 200
Electrical Patents . . . 201
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 202
Thermal Storage . . . 203
Electrification of the Metropolitan Railway of London . . . 203
INDUSTRIAL SECTION:
New Instruments of Precision . . . 204
A New Weatherproof Entrance Bushing . . . 205
An Electric Air Cooler . . . 205
Central Railroad of New Jersey Installs a New Gantry Crane . . . 206
Malleable Iron Insulator Pins . . . 206
Engineering Company of America . . . 207
New Forms of Incandescent Lamp Receptacles . . . 208
Electrical Ore-Finding Process Tested . . . 208
CURRENT ELECTRICAL NEWS . . . 209

THE BATTLE OF THE POWERS.

We have heard much of late about the efficiency of the steam turbine, and of the manifold advantages which this prime mover possesses, when compared with the old, but reliable, reciprocating engine. Occasionally the advocates of the gas engine have made themselves heard, and many fine examples, particularly of large gas engines, have been constructed and installed. These facts have had a stimulating effect upon the builders of the reciprocating type, who possibly, leaning on past laurels, were still advancing, though not at any startling rate. Now they have braced up and show a disposition to contest the field with the new—or, rather, rejuvenated—steam turbine and gas engine.

A Creditable Performance.

A recent report in one of our foreign contemporaries describes the results obtained not long since on a triple-expansion condensing reciprocating engine of only 210 brake-horse-power. This engine, operating with superheated steam and a high vacuum, developed its full load with a consumption of only ten pounds of steam per brake-horse-power-hour, and this efficiency was fairly well sustained for lighter loads, and even for less degrees of superheat. This is a performance which a large engine, or even a steam turbine, might well be proud of; and that it has been secured on a reciprocating engine of such small size is, indeed, a most creditable performance.

Each Type Has Its Troubles.

Each type of prime mover has its own peculiar troubles. The steam turbine has to contend with very high velocities and, in some types, with serious leakage. The gas engine pays tribute to its water-jackets in a large percentage of its heat. The reciprocating engine shares with the steam turbine the inefficiencies incident to the method of utilizing fuel energy, but in large sizes, at least, it is at the other end of the velocity scale. In small sizes there is no trouble on this score.

One Gain Sure.

Other systems of generating power from fuel have been suggested, but have not yet passed an experimental stage; so it is very probable that, for some years to come, the three prime movers now more or less familiar will occupy the field. As to the outcome, at least one prophecy may safely be made, and that is, a decided improvement in the efficiency and reliability of prime movers.

LEGISLATIVE POLICIES.

Protection of electrical interests requires more attention to legislation, especially if the popular movements toward regulation of rates, municipal ownership and the taxation of franchises are to be successfully met.

Of course it is not denied that rate regulation and franchise taxation are proper legislative functions, but the danger is that such measures may be carried too far unless there is some opposing force. This danger is due not to any inherent perversity of legislators, but rather to the fact that electrical systems are a shining mark and because the false idea has got abroad that they are earning excessive profits. Legislatures rather than courts must in a large measure be relied on for fair treatment in these respects. True it is that the courts stand ready to enforce the constitutional guarantees of property. But legislation that will just pass the constitutional bar is one thing, and legislation that represents good public policy may be quite another. A law that allows an electric light company to charge rates that give a net yield of only five per cent yearly on its investment may be constitutional, but a law that permits the company to earn as

much as ten per cent may be highly desirable. A franchise tax that eats up one-half of the earnings less operating expenses may not be one with which the courts can interfere, but such a tax may seriously hinder the investment of capital in electrical enterprises. In a large measure these are matters of public policy and arguments concerning them must be addressed to legislatures rather than to the courts.

Quite as important as rate regulation and franchise taxation is the question of municipal ownership of electric plants. The right of cities and towns to own and operate electric lighting systems is too firmly embedded in the law to be shaken, even if that were desirable. But there are differences of opinion as to the limitations under which this right should be exercised. If a city or town where there is a private electric lighting system is to go into the electric business it is thought by some persons that the municipal corporation should purchase the private plant. Such an obligation can be imposed on the city only by legislative action, such for instance as has been had in Massachusetts and Connecticut. It may be thought on the other hand that private interests can hold their own in competition with public management, if only the latter can be prevented from doing business at a loss. Here again legislative action is necessary to provide such a rule for the municipal operations.

Competition is a force of which the governing bodies of cities and towns are apt to think much more highly than do the local lighting interests or even some disinterested persons who have studied its results in many cases. Of course, promoters who see a chance to get a lighting franchise and subsequently sell out to the local electric company for a good figure can often demonstrate to a board of aldermen that competition is very desirable. Unless the granting of electric franchises is regulated by special legislation it is usually within the power of the municipal officers to permit as much competition as they desire in the local lighting field. The revocation like the granting of franchises is often entirely within the power of local governing bodies who may have very narrow views of what is good public policy in this respect. It is practicable by suitable legislation to give some central expert body, as a commission, authority to review all grants and revocations of electric franchises by municipal officers, and this plan seems to have worked well in Massachusetts.

Some check on local municipal action as to the structure and operation of electrical systems is also desirable, as town officers are not generally electrical experts, and city aldermen are not always modest in their demands for the expenditure of money by the local lighting system. A topic of especial interest along this line at the present time is the extension of underground lines and conduits. Such extensions are in themselves very desirable, but if carried out as far as demanded in some cities they would be a most serious burden on the earning powers of the lighting systems for years to come. Here, again, the right of appeal from the local municipal officers to an expert and disinterested state commission is of great value to the electrical interests.

The advantages incident to such a commission will hardly be obtained in most cases without some corresponding burdens. Electric lighting systems are after all engaged in a public calling and when they escape government control in one form they must usually submit to it in another. Nevertheless, some forms of control are much more tolerable than others. In Massachusetts the price paid for freedom from municipal and private competition, and for the right of appeal from municipal officers on questions of franchise privileges and structural matters, has been the obligation to report in detail both technical and financial operations to the state commissioners, and to follow the orders of these commissioners as to the rates for service and the issue of stocks and bonds. Judging by results the compromise in Massachusetts has been of benefit to all concerned. Probably no other state can show a higher degree of general prosperity for its electric lighting systems. On the other hand it would perhaps be hard to find a state where electrical energy is in more general use or where its prices for similar service are lower, the cost of fuel considered.

THE ELECTRICAL GENERATION OF STEAM.

Some time ago we commented upon a statement appearing in our European exchanges, to the effect that the Swiss government railway commission was considering the use of electricity for operating its trains, and that it had looked with favor upon the suggestion of a local engineer to retain the present equipment of steam locomotives, but to generate the steam by means of electric heaters placed within the boilers, the electrical energy being supplied to the locomotives from the many waterfalls available for this purpose. It now appears that this report was incorrect, and that it was based on an entirely different application of electricity in the generation of steam.

Steam from Surplus Electricity.

The large Davos sanitarium in Switzerland makes free use of electric power. Here, to avoid entirely vitiating the air in the buildings and the neighborhood, electric heaters have been introduced, and all the machinery about the place is operated by electric motors. Power for doing this is obtained from a waterfall some distance away, but the capacity of this is not sufficient when the greatest demands are made, so that it has been necessary to install an auxiliary steam plant in order to tide over the peak of the load. During the greater part of the day, however, the output of the hydraulic station is considerably in excess of the demand, and it occurred to the engineer that this excess power could be utilized advantageously if it were converted into heat and transferred to the boilers. In this way the boilers can be kept in a condition ready for operation, without the expenditure of coal. This is entirely different from that given in the first report and is good practice, provided, of course, there is no way of storing the water which would otherwise go to waste during the times

of light load. If this water could be stored without too great expense it would be the more efficient and therefore the better solution. However, there are doubtless modifying conditions which are not touched upon in the latest reports, but one is always justified in questioning a method which contemplates the degradation of electrical energy to heat only to raise it back again later on by an inefficient process.

SHALL INTERURBAN ELECTRIC ROADS BE GIVEN SUBSIDIES?

In a recent article in the New York *Commercial*, Mr. Guy Morrison Walker urges that interurban electric roads should be granted subsidies. He bases his argument on the fact that transcontinental railway lines—which have done so much for opening the great west to settlers, and have played so large a part in building up that section of the country—were granted subsidies in the form of public lands; otherwise their construction would have been impracticable, as for many years there could be no prospect of profitable returns. A precedent being thus established, Mr. Walker claims that we have reached a stage in our development where the construction of more interurban electric railways, to supplement the steam lines, is necessary, and he shows that there are many localities where interurban roads are desirable, but where there is no prospect of a profitable investment. He contends that an attempt to make such an investment profitable by raising rates would defeat the very end which was sought, as cheap rates for transportation of passengers and freight is one of the great factors in building up any community and in increasing the traffic. Such roads, Mr. Walker believes, would not compete with the steam roads; they would, rather, supplement them, relieving the steam road of its short-haul passengers and collecting freight in small lots, to be delivered for further transportation on through trains.

The Argument Not Convincing.

This argument is hardly convincing. The cross-continental lines passed through a country having no means of transportation except by means of horses or oxen, and the subsidies the roads received were not in the form of an additional tax upon the public. Interurban electric roads at the present time would be a luxury, rather than a necessity, in a large number of places. Where they are actually needed, the capital will be forthcoming as a profit is reasonably assured. If the traffic in any locality is not large enough, or the people there are not willing to pay high enough rates to make an electric road profitable, the best that can be said is that that section is not yet ready for an improved service. To give it such a service by taxing communities in no way benefitted would certainly be unjust. If, on the other hand, the subsidy is to be raised by a tax upon those directly served by the road, it is hard to see how this would be any better than making the rates higher. If Mr. Walker's argument were allowed for interurban railways, it would be easy to make out an equally strong case for an electric power supply system or any other service, and it would be hard to see where the line should be drawn.

ELECTRICAL TRANSMISSION ELECTROSTATICALLY TREATED.

BY J. STANLEY RICHMOND.

It has always appeared to me as if the consideration and manipulation of electrostatics and electrical transmission of energy have been and are carried out, unfortunately, on the basis that such are, in the main, distinct and separate phases of that branch of science designated as electricity.

As a fundamental principle and to serve as a starting point, allow that all electrical phenomena are due to the inequality of some particular condition of one body of matter as compared with the similar condition of some other body; or, if more satisfactory, due to the inequality at two different points of some condition of a body of matter. Term this condition of matter its electrical condition.

Now, from our knowledge of electrostatics, we are aware that this condition can by various processes be raised or lowered; just the same as we can raise or lower that condition of matter which is known as temperature condition, or like we can raise or lower that condition of matter known as pressure condition. Unfortunately, we can not at present obtain a satisfactory arbitrary zero electrical condition from which to measure; like we can in temperature and pressure conditions. As a result, every measurement of electrical condition has to have its own zero; unless we simultaneously make several measurements of the electrical conditions of various bodies as compared with that of the electrical condition of one body as our zero.

Electrostatically, all students of electrical science know how the electrical condition of a body can be raised or lowered; or be made, as it is generally termed, + or —. But it does appear as if several students ignore, or else forget, what the fundamental principle producing electrical transmission of energy is. A so-called current of electricity (direct current, for simplicity) is nothing more or less than the transmission of energy due to the difference of the electrostatic condition at the two ends of a circuit being constantly kept up by some generating device. A direct-current generator, therefore, is simply a device for producing and keeping up a steady electrostatic difference between two points.

With an alternating-current generator having two poles, A and B, and if B is earthed, then during the first half of the cycle, the electrostatic condition of B being fixed, the condition of A will be gradually raised to its maximum above B; and then gradually fall until it is the same as B. And during the second half of the cycle, as the condition of B can not change and as the direction of transmission is the reverse of what it was during the first half of the cycle, the electrostatic condition of A will gradually fall to its minimum below B; and then gradually rise until it is the same as B. And these results during the two halves of the cycle will be reversed if A is grounded instead of B.

If the medial point between the two poles is earthed, then the electrostatic condition of A and B during the first half of the cycle will gradually rise and fall, respectively, until the maximum difference of condition between both is reached; when they will fall and rise, respectively, until they are equal. During the second half of the cycle, A and B, owing to the reversal of the direction of transmission, will gradually fall and rise, respectively, until the maximum difference electrostatically between them is reached; when they will gradually rise and fall, respectively, until they are again equal.

Following out this fundamental prin-

ciple of electrical condition, let us endeavor to obtain, if possible, some conception of the conditions existing during the transmission of energy electrically.

1. We all, more or less, understand the chemical theory of molecular composition of matter.

2. Students of physics understand the theories of molecular motion.

3. The majority are aware of the ether theory.

4. The various factors appertaining to the reduction of ore (say copper ore), the thereby production of copper ingots and the drawing out of these ingots into copper wire are not unknown to many.

5. That two bodies of metal separated by some different material constitute a condenser and the electrical changes which can result in a condenser by correct manipulation are known to all electrical students.

From (1), we can safely state: that it would be impossible to have molecules unless some matter separated one molecule from another.

As a result of (2), we can safely state: that molecular motion is some definite action of one molecule on another molecule.

On analysis, (3) gives the following: ether can not in any way, shape or form be described. It is purely hypothetical; and so we are absolutely unable to liken it to anything, or form any conception of what it is. If possible, it appears advisable, therefore, to substitute in its place something that we can form a conception of and which, at the same time, will serve in these metaphysical questions the same purposes as this hypothetical ether. Let this be the matter which, owing to the circumstances attending the formation of a body, would be most likely to naturally act as what we may term the "separant" between the molecules forming such a body.

As a result of (4) and taking for consideration a copper wire, let us assume in the place of the hypothetical ether that the molecules are separated from each other by some infinitesimally less than microscopic amount of oxide, or slag, or gas. Chemistry largely supports this; for no matter how careful the smelter may be no copper can be obtained without impurities. And the cleaner the method of reduction the purer the copper will be.

As a result of (5), we can safely state: that any two molecules with the separating matter between them form a condenser. Now we know that the closer the core of a lead-sheathed cable is to the grounded sheath (that is, the thinner the insulation or dielectric is), the greater is its capacity; or, in other words, the greater is the amount of energy which can be stored up in it. And we also know that energy, leaving out the time equation, consists of volume and pressure. Therefore the less the amount of separating material existing between two molecules, the higher we can charge the molecules. But it has been shown that the less the separating matter is the purer the copper is. As a result, we have the accepted and proved fact, which is often quoted, that the purer copper is the better conductor it is.

The late Lord Armstrong, of hydraulic and ordnance fame, and I were much agreed on some of these metaphysical questions; and it will do no student of such any harm to read his book on "Movements of Electricity in Air and Water." And I am certain that a careful examination of the photographs of his dust pictures (formed on plates of bitumen with red lead and sulphur dust powdered over them) and electrical discharges, which I had the pleasure to personally go over with him in his private laboratory, will prove not only interesting, but also very instructive. My only regret is that he died when a few more years of life, coupled with his financial standing, might have enabled him to fully develop some of these most fascinating ideas.

Following up this theory of molecular condensers, the student will easily understand that when the molecules, as a result of being overcharged, discharge, heating will take place; so that if we take a small piece of material, such as a carbon filament, the molecular characteristics of which (chemically considered, or the number of molecules to a given cross-section) prevent it from becoming highly charged, relatively speaking, and insert it in series with the copper wire of a circuit, the carbon molecules will discharge to such an extent that they will become intensely heated. And if the amount of filament (thickness and length) be so proportioned, or so balanced in relation to charging and discharging, that the discharging simply produces incandescence without disintegration of the filament, we then have the incandescent electric lamp of commerce.

If the foregoing is correct, it is easily understood that so-called conduction and induction are really one and the same thing; and that the whole science of electricity is really one of electrostatics; or, in plainer words, of the relative pressures of the electrical conditions of bodies of matter.

May we or may we not say, therefore, that conduction is but induction repeated over and over again across dielectric mediums that are infinitesimally thin?

Excellent Performance of a Reciprocating Engine.

Excellent results have been obtained by Messrs. Willans & Robinson, of Rugby, England, with a triple-expansion engine of their central-valve type, operating with superheated steam. Willans engines have been operating for some years with steam at a temperature from 600 degrees Fahrenheit to 700 degrees Fahrenheit, and no difficulty has been experienced in obtaining suitable lubrication, although a special oil is used. It is thought that the symmetrical type of cylinder, in the absence of irregularly shaped valve chests, prevents distortion under high temperatures; and, further, that the absence of anti-friction metals removes a frequent source of trouble when superheated steam is used. All glands in this engine are packed with phosphor-bronze or with cast-iron rings. These are spring rings—not solid—which produce a joint always tight, but with sufficient clearance. Tests of a 210-brake-horse-power engine of this type, with different degrees of superheat and under different loads, showed that for full load and no superheat, the consumption per brake-horse-power-hour in pounds of water was 14.6. With 100 degrees superheat, the consumption was 12.5 pounds. With 200 degrees superheat, it had fallen to 10.9, and with 260 degrees, the consumption had fallen to ten pounds of water per brake-horse-power-hour. At three-quarters load the performance was nearly as good, the consumption being, for the degrees of superheat mentioned, 15.5, 13.1, 11.5 and 10.8, respectively. At one-half load the consumption was, on an average, about one pound greater than for three-quarters load. On one-quarter load it was, for no superheat, twenty pounds, and for 260 degrees superheat, 12.2 pounds. This engine was running at a speed of 400 revolutions per minute, taking steam at 185 pounds boiler pressure, with twenty-eight inches vacuum.

Railroad School for Telegraphers.

The Canadian Pacific Railroad has opened a school for the teaching of telegraphy and shorthand to employés at Montreal, which has proved a great success.

Some Points in a Comparison of Types of Railway Motors.

The following are some of the points in a comparison of different types of railway motors made by Mr. Oskytel H. Clarke in an article entitled "Factors Influencing the Economic Design of Single-Phase Railway Motors," published in the *Polytechnic Engineer.*

Comparison of Straight Series and Repulsion Motors—There are two different magnetic fields in different parts of the repulsion motor, so that the magnetic circuit must be of large cross-section in all parts to have a sufficient amount of iron to carry properly the magnetic flux. There is but one field in the series motor, consequently the section of iron does not need to be uniform. In general, then, with the same performance, the straight series motor should be lighter than the repulsion type. A motor embodying both a motor and a transformer in itself would naturally be heavier than a motor alone.

One of the difficulties in securing sparkless commutation in alternating-current motors of the commutator type is the current appearing in each armature coil when short-circuited by passing under a brush. Owing to the transformer action, the armature current in a repulsion motor will be slightly less for a given field current than that of a straight series motor having the same ratio of armature turns to field turns, and it will also be somewhat out of phase with the field magnetism. The repulsion motor will therefore require a greater field current than the straight series motor for a given starting torque. Hence there should be a greater short-circuit current at starting and at low speeds than in the case of the straight series motor. There may be slightly less short-circuit current at high speeds, but the effect of this current is most serious at starting and at low speeds.

It is a difficult task to insulate a railway motor, placed beneath a car and subjected to dirt and water, for high voltages. Considerable trouble is caused with 500-volt direct-current railway motors by the insulation breaking down. With voltages of 1,000 or more the difficulties would probably increase with much greater rapidly than the voltage. The employment of alternating current makes the insulation of the windings of particular importance. The only voltage between field turns in a direct-current motor is that due to ohmic drop. In the alternating-current motor, the field turns have an active voltage due to the alternating flux through them, similarly to the coils of a transformer. A direct-current motor might continue to operate with several adjacent field turns short-circuited. In the alternating-current motor, a large current would be developed in the short-circuited turns, which would probably burn them off and thus make the motor useless. The fact that the straight series motor may be wound for a low voltage and used with a separate transformer, while the repulsion motor can not, without a loss as regards weight, constitute a decided advantage for the former.

The employment of a separate transformer possess another advantage, since the equipment may be operated at different trolley voltages by simply connecting the trolley to different taps on the transformer.

Under the best circumstances the repulsion motor may be started under full load with a current only slightly exceeding the full running current. This great advantage is obtained without any expensive and cumbersome starting apparatus and this is the main point in favor of this type of motor. At starting, the motor is really a special case of the split-phase type of motor and the sole reason for its being so much better than other motors depending upon this principle is that the phase splitting is performed by the motor itself, independent of any additional arrangement. Further, by careful design, the phase difference produced at starting is much greater here than in any starting device for single-phase motors, except such as depend upon the introduction of a very large condenser.

Immediately upon the attainment of a sufficiently large starting torque, the rotor of a repulsion motor commences to revolve. By Lenz's law, the electromotive force generated by rotation opposes the lagging rotor current. Hence, as soon as the revolution of the rotor commences, the lagging rotor current is reduced or the coefficient of self-induction of the rotor coil is virtually diminished. When the rotor is revolving, any given coil is immedately replaced by the one next to it and this, although the rotor actually revolves, it is correct to speak of as an "equivalent stationary coil," whose axis is determined by the diameter upon which the brushes are set. Considering the given coil as representing this equivalent stationary coil, it can be seen that its coefficient of self-induction may be altered to a certain extent by moving it in the direction of rotation. By this method, however, much of the phase of the rotor current may be altered by the electromotive force due to rotation, the original conditions may be readily reproduced by moving the brushes in the direction of rotation. Theoretically this may be continued until the axis of the coil is at right angles to the axis of the field, when the speed of the rotor is infinite. In practice, there is, naturally, a limit, depending upon the particular form of starter and the torque necessary to overcome the friction of the rotor bearings, etc.

The principal difficulty in commutating alternating-current motors has been the presence of local secondary currents in the coils short-circuited by the brushes, these currents being due to pulsating or alternating magnetism through the short-circuited coils. At different times, various arrangements have been tested for lessening the effect of these secondary currents. It is usual to equip such motors with a comparatively large number of commutator bars, with a very small number of armature turns per bar, to lessen the effect in the short-circuited coil. Very narrow brushes have been tried in order to lessen the period of short-circuit, and two or more parallel windings, forming the so-called "sandwich" type, have been tried. These windings lie side by side on the core, but are practically independent of each other and are connected to alternate commutator bars, or to every third bar, depending upon whether two or three parallel sets are used. With two such parallel windings on a core a commutator brush of a width slightly less than one bar could be so placed that it would never short-circuit a coil of either winding. In this case, the brush passes from one winding to the next, breaking connection with the first winding before passing to the next bar of the first winding. This arrangement would diminish the short-ciruiting of the coils but the type of winding is not considered satisfactory for railway motors. It is simply transforming the trouble due to the short-circuited coil to another which would be just as serious in the end, *viz.*, the tendency of such windings to produce blackening and pitting of the commutator bars. Such an arrangement would require very thin brushes, if only two parallel windings were employed, while with three parallel windings, the brush could have a thickness corresponding to two commutators bars.

In all these motors it should be noted that there should be but little saturation in the magnetic circuit, and but few ampere-turns expended in saturation of the iron under normal conditions. This consequent low saturation in such motors

leads to certain characteristics in the torque curves which have been cited as an indication of superiority of alternating-current motors over direct-current motors, *viz.*, a torque increasing approximately as the square of the current. This superiority of torque should, in fact, be charged to the non-saturated condition of the motor rather than to the alternating current principle. If direct-current motors were normally worked at as low induction as the alternating-current motor, the former would show better torque characteristics, which would be comparable with the alternating-current motor.

With the repulsion motor, the torque depends upon the relative phases of the stator and of the rotor currents, and at starting it is a maximum when the power-factor is about sixty per cent. The torque will always be a maximum at any speed with approximately this power-factor, but in order to maintain this maximum torque it would be necessary to move the brushes gradually in the direction of the rotation as the speed increased. With small motors, there is no apparent reason why the brushes should not be moved forward in this manner, either automatically or by hand, since the sparking difficulties may be completely overcome.

If the maximum torque is required of the repulsion motor at starting and the brushes are kept fixed, it follows that the power-factor can never exceed seventy per cent. This appears to be a serious drawback at first sight, but there are many cases in actual practice where it will be no disadvantage whatever.

After efficiency, the consideration of power-factor is the next most important one in the performance of single-phase motors. It is a feature which does not appear at all in direct-current machines, the apparent input in such motors representing true energy. In the single-phase railway motor, on the contrary, in general the apparent input does not all represent true energy, a certain component of the input being required to magnetize the motor, this component representing practically no energy. Magnetic leakage in the alternating-current motor also represents a component of the apparent input which is practically wattless.

In a straight series motor, a certain magnetizing current is required with a given field winding. The alternating flux through the field winding sets up alternating electromotive forces, which lag practically ninety degrees behind the energy component of the motor, the product of the field current by the field voltage thus representing a wattless component of the motor input. The field current and the induction increase with increase of load, the field volts therefore increasing also. The wattless component in the field thus varies with the product of two values which are both increasing with the load. The energy supplied to the motor increases approximately in proportion to the current supplied. The wattless component in the field therefore increases more rapidly than the energy component. Hence, if this were the only wattless component in the motor, the power-factor would decrease with increase of load, being highest at no load. Other wattless components of the input are represented by the cross-magnetizing effect of the armature if it exists, and by the stray field around the windings. These effects also increasing more rapidly than the energy component, it is evident that the power factor in this type of motor will be highest at no load or at highest speed, decreasing with the load or speed with a given voltage applied. If the windings are so proportioned that the wattless component at the rated capacity is relatively small, a high power-factor will be obtained at the rated load and speed. The power-factor would be considerably higher at lighter loads and higher speeds. At half loads, with correspondingly increased speed, such a motor is capable of giving a very high power-factor. If the motor is operated at lower voltages, then the power-factor at a given speed will be very nearly the same as when operated at the same speed, at a higher voltage and a heavier load. Hence, it is evident that as the speed is reduced, no matter what load is carried, the power-factor will be decreased, and at the start the power-factor will be lowest, the energy component in this case representing only the losses in the motor. A test of a 100-horse-power motor showed ninety-two per cent power-factor at 100 horse-power, and approximately ninety-eight per cent power-factor at one-half load, the voltage being identical in both cases. The question of power-factor is largely one of design, the magnetizing or existing component of the input depending upon the air gap, amount of material, etc. In general, a larger air gap means more exciting current.

Comparing the straight series with the transformer type of motor, it should be noted that the former requires less magnetizing current, this current being supplied to one element of the field only. With the transformer type, a magnetizing field must be furnished as in the straight series, but a second field is also set up due to the transformer action, this latter requiring a magnetizing current also. It may therefore be considered that two magnetic fields are set up, approximately ninety degrees apart, each field requiring a certain magnetizing current. These two fields may be regarded as forming one resultant field of higher value than either of the components, with a magnetizing current of higher value than either component. In the series motor, the transformer portion of the field can practically be made to disappear, the exciting field only remaining; the resultant induction is, therefore, much less than with the transformer type, the field having an approximate average value of seventy per cent of that of the transformer motor, the magnetic circuit being proportionally reduced.

It is therefore apparent that the straight series motor can be made to give a somewhat higher power-factor than the transformer type, the field being employed as a transformer, this being obtained with somewhat less weight. At higher speeds, this difference in power-factor could be compensated for by some method of excitation applied to the armature through the commutator, as indicated above. But for traction service, where it is desirable to have the least weight with great compactness of design, it would appear that the straight series motor possesses some advantages. The transformer type of motor, with the transformer in the motor itself, may be compared with the straight series motor provided with a separate transformer, if high voltages are to be used on the line. It is considered that a number of more compact motors under a car with one separate reducing transformer composes a more suitable combination than a similar number of larger motors, each with its transformer inside itself.

In any class of electric motor, the efficiency is bound to depend largely upon the amount of material used in its construction, comparison being therefore inadmissible between motors of different types and of the same weight. The repulsion motor for a given power output will be heavier than the corresponding polyphase motor, and lighter than the single-phase motor with its starting apparatus. Considering the enormous waste of energy in starting the latter, the repulsion motor will be far more economical for intermittent operation.

In these commutator types of single-phase motors, the two most important elements, besides the speed characteristics, are the efficiency and the power-factor. The efficiency of such motors will usually be less than that of a direct-current railway motor of the same output.

The efficiency curve has very much the same shape as the efficiency curve of a direct-current motor, with changes in load and with a given applied voltage, since it starts low at light load and high speed, rises to a maximum, and then falls off considerably at very heavy overloads.

In conclusion, it should be remembered that economies will not be effected by the single-phase system because of any advantage of the alternating-current motor over the direct-current one but rather through the employment of alternating current. The motor itself is merely a single element in the system but it is such an important one that essential advantages may be gained by employing motors of the proper type.

The Palermo-Monreale, Italy, Incline System.

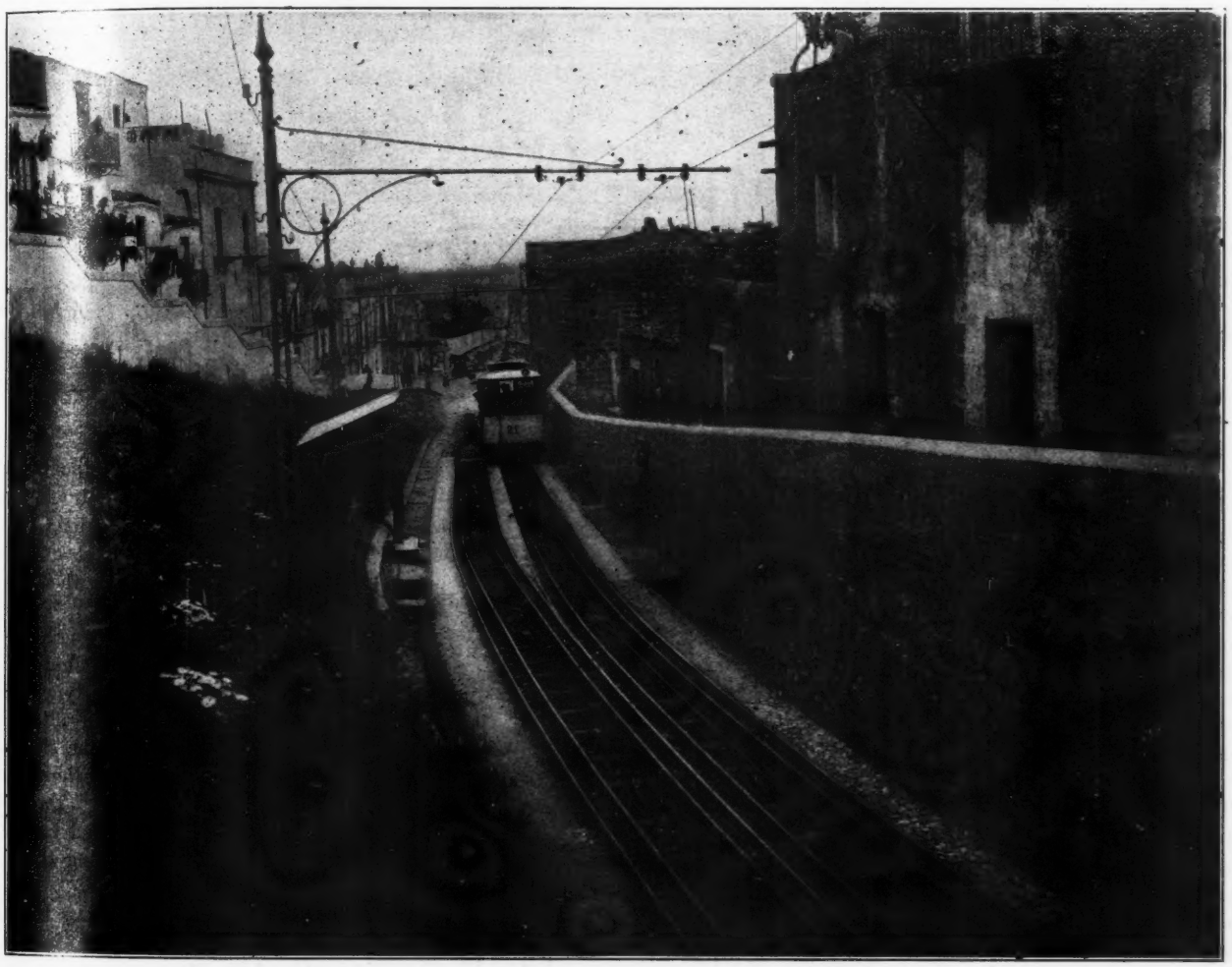
By C. L. Durand.

THE incline which runs from Palermo to the suburban town of Monreale in Sicilian Italy is operated by an electric system which presents some interesting features. Monreale is a small town which is situated at a considerable height, and as it is much frequented by tourists both on account of its cathedral and the splendid view which is obtained from this point, it was desired to connect it with the city traction lines of Palermo. This has now been done by a very efficient method, in which the cars are taken directly up the incline without having to use two types of passenger cars. The line measures 6,700 feet on the horizontal, and the top station lies 604 feet above the lower. The plant was installed by the Continental Company, of Nürnberg, Germany, together with the Schuckert Company.

The problem to be solved in the present case was to bring the ordinary motor cars of the Palermo system up to the height of Monreale without being obliged to make any changes in the construction of the cars, either by providing them with special brakes or with the apparatus which is needed for mountain climbing. The mechanism which is needed in this case is supplied by a special form of car known as *carro-freno* or brake car, whose function it is to carry the brakes, which need to be especially powerful on the incline, and also to carry an auxiliary motor which can be used in connection with the motors on the cars.

The inclined system which is thus operated is divided into three sections. The first, about 656 feet long, starts from the lower station and uses single track; the second, 3,540 feet long, uses double track with a common middle rail. At the top is the third section, 2,612 feet long, in single track, of which 1,640 feet run through the town of Monreale. Between the rails of the main track in the middle section is a second track of smaller gauge upon which the brake cars run. The second section of the line has a rather steep grade of ten to twelve per cent, while the end sections have four and eight per cent respectively.

The steep grade of the middle section does not allow of using traction with simple adherence, at least in wet weather, and on this account it was necessary to adopt the special arrangement which characterizes the present system. Under this plan, the two cars which run upon the line, one on the up-grade and the other on the descent, when they come upon the middle section cease to be independent and each of the cars is coupled to one of the brake cars. The two brake cars are attached to each other by a steel



A Portion of the Road at the Lower Station, Palermo-Monreale (Italy) Incline Railway.

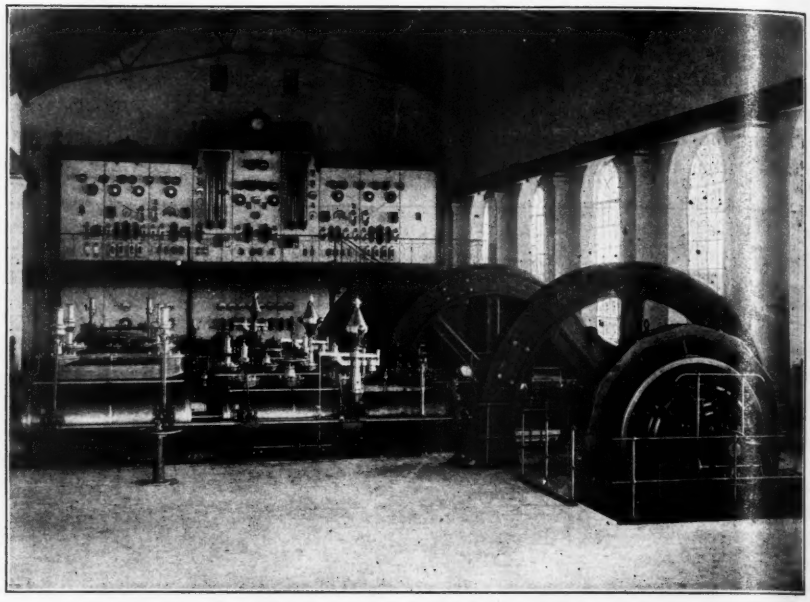
cable which passes over a pulley located at the top of the line. The brake cars take current from the trolley line which continues up the incline, in the same way as the motor cars. This arrangement allows the descending train to draw the ascending train upon the other track by means of the cable.

Such an inclined system, compared with the rack-and-pinion system which is commonly employed in such cases, presents the noteworthy advantage of requiring less tractive power, seeing that the weight of the descending car is now brought into requisition to furnish part of the force. The remainder of the power needed to operate the trains is given by the motors of the descending car and also by the motor of the brake car. In this way it is possible to limit the size of the motors to the usual traction type, thus satisfying the condition that the same car shall be used for the city service as well as on the Monreale line. This has also the advantage of avoiding a transfer of passengers, and thus unifies the system.

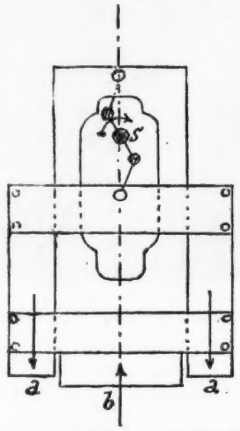
The brake cars are provided with a set of mechanical brakes which are either operated by hand or come into play in case the tension of the cable should fail. These cars are coupled on the down-grade side of the motor-cars in each case. A very simple and effective method has been adopted which allows the rapid coupling and uncoupling of the brake cars and the motor cars. This will be made clear by referring to the engraving which shows the general disposition of the track in the inclined part and also the station where the car commences the ascent. At this point the double track with a common inside rail commences. The trolley wire is suspended over each track by a bracket post at one side of the road. Between the main tracks is the smaller track for the brake cars; it has a set of rollers spaced at intervals upon which the cable rests.

The manœuvre of the brake car is quickly carried out. When out of action, these cars lie in a depression at the end of the line and when in this position they are below the level of the main track. The motor cars coming from Palermo can thus pass over them for a distance of six or eight feet. At the same time the other car at the top of the incline, coming from Monreale, now lies just above the second brake car. The latter is then run out on to the main track and is coupled on to the lower side of the motor car. The upper train is then made to descend for a short distance until the lower brake car is drawn out of the pit by the traction on the cable and has rejoined the lower motor car. It is then coupled behind the latter and the train is ready for the ascent. To carry out the latter manœuvre, the lower motor car will have already advanced from the position shown in the engraving to a point on the up-grade side of the brake car.

When this train has arrived at the upper station the motor car is uncoupled and resumes its ordinary functions, proceeding on its way to Monreale, while the brake car is run in and is now ready to recommence the manœuvre and begin the descent with a motor car. At the same time the lower train has arrived at the bottom station. The motor car is uncoupled and runs by trolley to Palermo, while the brake car is run into the pit. At the middle point of the incline there is a short section of double track which allows the cars to pass each other.



THE PALERMO CENTRAL STATION, PALERMO-MONREALE (ITALY) INCLINE RAILWAY.



BRAKE USED ON PALERMO-MONREALE INCLINE RAILWAY.

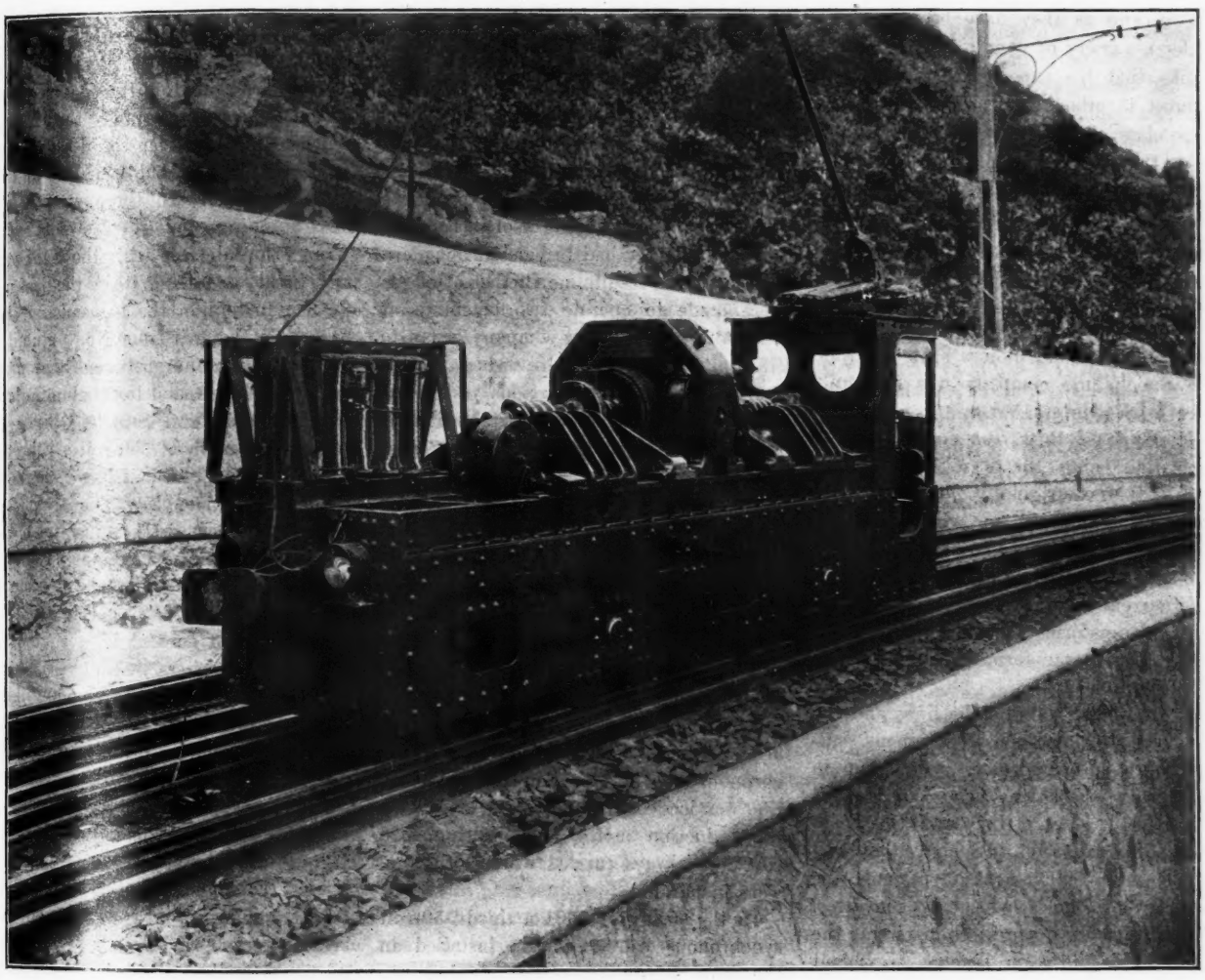
The cable at the top station passes over a horizontal pulley ten feet in diameter, and it thus takes the middle position in each track. The cable is guided at this point by four main sheaves, two of which are placed horizontally and two vertically. They are placed in two pits lying under the middle of the tracks at the point where the single-track section branches to double track. Along the line the cable is guided by a set of smaller sheaves which lies between the rails at equal intervals.

The motor cars which are used on the Palermo city lines and the Monreale section are of the double axle type, with a capacity of forty places in all. Each car carries two motors of the Schuckert pattern. The total weight of the car when empty is about eight tons. Two brake systems are used, one a hand brake and the other obtained by working the motor in short-circuit.

One of the engravings shows the brake car which is one of the interesting features of the Monreale system. It was designed by the Schuckert Company. Ordinarily it has a top cover which is now removed to show the different parts of the mechanism. The car is fifteen feet long (five metres between buffers) and has two-foot three-inch wheels. The distance between axles is five feet three inches. The brake car carries a single four-pole motor, whose shaft is connected by worm gearing with two other shafts. One of the latter is connected with one of the main axles of the car by ordinary gearing. In front is the motorman's cab which contains the controlling apparatus

for the motor and also the brake levers. Two powerful brakes are mounted upon the cars. One of these is operated by hand and the other is connected by an appropriate device with the main cable and is automatically thrown on by a counterweight in case the cable becomes slack. Both these brakes are exceptionally strong. They are of the Esslingen type and operate by gripping the head of the rail. Referring to the diagram, the brake is composed of a central part *a a*, which slides upon the upper part of the rail and two lateral parts *b b*. When the brake is thrown the latter mount up and press against the underside of the flange. This gives a sure action which prevents the car from rising above the rail as well as stops its movement effectively. This diagram shows the method of raising the parts *b* and lowering the part *a a*. The double movement is carried out by the rotation of the shaft *s*, which carries two short strong arms for operating the brakes. Hand and automatic action are both employed. In the hand brake the shaft *s* is rotated by a lever which is adapted to the purpose. For the second brake, the tension of the cable, which is attached to a lever, keeps a counterweight lifted, and in this case the brake remains open. Should the cable break, or even become slack, the weight falls and causes the rotation of the shaft *s*, thus throwing on the brake.

The Monreale system has been found to work very successfully since the start.



THE BRAKE CAR USED ON THE PALERMO-MONREALE (ITALY) INCLINE RAILWAY.

The writer has been informed lately by Signor Piazzoli, director of the Societa Sicula, which operates the traction lines in Palermo, that the use of the motor on the brake car has now been dispensed with, as it was found that the motive power of the car is sufficient to operate the system without needing any extra power.

Current for the extensive traction lines in the city of Palermo, including the above mentioned section, is furnished from a large central station which has been erected in the central part of the city. Our engraving shows one of the large generators with which the station is equipped, also the main switchboard, which is built of white marble panels and placed in an elevated position in a gallery. The electrical outfit of the station has been supplied by the Schuckert Company. The generators are direct-driven from horizontal compound engines.

Three of these generators form the outfit of the station, at last accounts. These machines are of the twelve-pole type and the armatures are mounted, together with a large flywheel, upon the main engine shaft. Their capacity is 600 horse-power and they deliver either 300 or 600 volts, direct current. To this end each of the generators is equipped with a double commutator, one on each side of the armature. Two large batteries of accumulators are used in the station. One of them serves for the lighting circuit and is coupled so as to deliver 300 volts in two series of 150 volts each. The second battery works in parallel with the main generators to furnish current for the traction lines, in order to equalize the load and provide against shocks. This battery delivers 600 volts. Both sets are of the Tudor pattern.

OPERATION OF SYNCHRONOUS CONVERTERS.[1]

BY S. C. LINDSAY.

It is the purpose of this paper to give a history of the experience we have had with sixty-cycle synchronous converters in Seattle during the last three years and a half. As the Seattle Electric Company has a greater capacity in sixty-cycle synchronous converters in daily operation than any other company in the United States, and as they have been operated under a variety of conditions, the writer thinks that his experience might be of interest to others who are operating the same class of apparatus.

In the summer of 1900 we put into service two 550-volt compound-wound synchronous converters which were supplied with alternating current from the Snoqualmie Falls Power Company, the direct current from these synchronous converters being used to operate street cars and stationary motors. At that time the Snoqualmie company was transmitting to Seattle at 15,000 volts over two- to three-phase lines, the conductors for each line being No. 2 solid aluminum wire. It was originally planned to use one line for power and the other line for lighting and such power loads as were not subject to large and sudden changes. The current for the synchronous converters was transformed to 340 volts by three 500-kilowatt transformers connected in Δ on both sides.

With 15,000 volts on the lines and the lines in multiple, one synchronous converter would operate satisfactorily up to full load; when the second synchronous converter was put in they would begin to pump immediately, although the load would not be increased beyond the capacity of one synchronous converter. If both machines were left in circuit the pumping would soon become so violent that the transmission line circuit-breakers at the power-house would open. Various adjustments of the field strengths between maximum and minimum improved matters very little. It was tried a number of times to operate two machines under this condition, but without success. At times there would be several hundred horse-power of induction motors in Seattle operating from the same system. We tried to operate the synchronous converters both with and without the induction motors in service, but without success, the results being a little more favorable with the induction motors running.

When the transmission lines were separated in Seattle, but still supplied from the same bus-bar at the power-house, we tried to operate a synchronous converter from one line and the induction-motor load and lights from the other line; with a very weak field a single synchronous converter would run comparatively steady without load, but would pump violently when loaded to one-third of its rated capacity, especially if it were a street-railway load. With the lines divided as above, two synchronous converters were synchronized on the same transmission line, but were not loaded nor even paralleled on the direct-current side. After running under this condition for a few minutes they began to pump, and the pumping soon became so violent that they had to be shut down.

After these results, no further attempts were made to operate two machines at a time until the power company began to transmit at 30,000 volts, when it was found that both synchronous converters would operate entirely satisfactorily up to their full capacity with the transmission lines in parallel, and when the lines were separated one synchronous converter would operate perfectly up to full load and fifty per cent of overload, but when the second machine would be switched in pumping would commence unless the load was reduced. We could carry more load without any disturbance on one machine than we could on the two. It must be borne in mind that when these attempts were made to operate two synchronous converters from one line the line was loaded in almost every case with the induction motor and lighting load that was always carried when both lines were in parallel.

In the spring of 1901 a third 550-volt synchronous converter was installed in the same substation with the other two machines, and connected to the same bank of step-down transformers. When the three synchronous converters were running at the same time they were, of course, in parallel on both their alternating-current and direct-current sides.

A 250-volt, shunt-wound, 500-kilowatt, two-phase synchronous converter was also installed at the same time in another substation about one-quarter of a mile from the station where the 500-volt synchronous converters were installed, and was operated from the same system.

The addition of these last synchronous converters caused no trouble whatever as long as both transmission lines were in parallel, but when it became necessary to place the entire Seattle load on one line it was found that the 250-volt synchronous converter and one 550-volt synchronous converter would operate satisfactorily, but that two 550-volt synchronous converters would not operate satisfactorily when the 250-volt synchronous converter was shut down.

When the transmission lines were multiplied at Renton, and one line cut out between Seattle and Renton, all of the load in Seattle being carried by a single line between these two points and the two lines between Renton and the power-house, all of the 550-volt synchronous converters and the 250-volt synchronous converter could be operated at the same time, but when all of them were heavily loaded there was more or less pumping, but it was not serious enough to interfere with the lighting to any great extent. Within the last year the conductors in the transmission lines have been changed from No. 2 aluminum to 0000 aluminum between Renton and the power-house, and to 00 aluminum between Renton and Seattle. Since this change two or more 550-volt synchronous converters can be run from a single line without any trouble. The trouble experienced when first trying to operate more than one synchronous converter from a single line must have been due to excessive line drop which caused an interchange of current between the synchronous converters.

While operating the three 550-volt synchronous converters from the same bank of transformers it was necessary to use great care in adjusting their field rheostats so as to keep the load equally divided between the synchronous converters. If one synchronous converter was given a weak field and the other two a strong field, pumping would commence and soon become serious if the proper adjustment were not made. We had all three synchronous converters thrown out of synchronism several times from improper adjustment of their field currents. While operating under this condition it was found that a dirty commutator or too much oil applied to a commutator for the purpose of lubrication would cause serious trouble, and on one or two occasions threw all machines out of synchronism. Shifting the brushes to find the neutral point was also a prolific source of trouble. After these causes of trouble had been discovered we got fairly good results, but only by the most careful attention to the machines.

Experience with these rotaries operat-

[1] A paper presented at a meeting of the American Institute of Electrical Engineers, Seattle, Wash., April 14, 1904.

ing from one bank of transformers leads the writer to believe that a worse combination can not be had, and is something that should never be done except as a makeshift.

After running under this condition for two months a separate bank of transformers was installed for each synchronous converter, each bank consisting of two 300-kilowatt transformers transforming from 2,200 to 340 volts, these transformers in turn being connected to a single bank, transforming from 30,000 to 2,200 volts, both transformations being made on the Scott two-phase to three-phase system. This change in no way affected the results of an attempt to operate on a single transmission line, but the troubles experienced from operating the three synchronous converters from a single bank of transformers were entirely removed.

The one thing that has caused more trouble than any other in the operation of synchronous converters, and the thing that has been responsible directly and indirectly for over ninety per cent of all the troubles we have had with them, has been the frequent breaking down of the transmission line. Almost every time the line would break, all of the 550-volt synchronous converters then running would flash-over at the commutator, making a loud report very similar to the discharge of a cannon. The breaking of the line caused a rise of pressure at the commutator of the synchronous converters great enough to jump the space between the positive and negative brush-holders of the machines. There were only two or three cases when the line broke down that the flashing-over did not occur. On several occasions when the line broke armature coils were burned out simultaneously with the flash. The flashing did considerable damage each time it occurred, by burning the commutator and brush-holders and tearing away parts of the mica insulation between the copper segments, which left small pockets that soon filled up with particles of copper and carbon dust. Whether the rise of pressure at the commutators was caused by the sudden opening of the line or by a short-circuit between the broken wires and the other two line wires is a matter that has never been determined, as no one qualified to make an intelligent report was ever present at the point of trouble when a break occurred. This trouble was finally stopped by grounding the neutral point of the two-phase windings of the step-down transformers. Although this was done primarily for another purpose it produced an effect on the synchronous converters that we had long desired.

If the commutators are in first-class condition the damage done by a single flash has never been sufficient to cause serious trouble unless armature coils were burned out; the damage to the commutator being quickly removed by the use of a file and coarse sandpaper. When line troubles were quite frequent, say three or four times a week, the damage done to the mica segments by one flash would not be removed before another flash would occur, and the result was that a number of mica segments in each commutator would be wasted away from 1/32 to 1/16 an inch below the surface of the copper segment. These places would soon fill up with particles of carbon and copper dust, causing short-circuits between segments. These short-circuits would burn out, causing a flash and explosion at the commutators very similar to that caused by line troubles, the principal difference being that current did not disappear from the transmission line when trouble was caused by these short-circuits. We experienced a great deal of difficulty from these short-circuits before the cause of the trouble was determined. The difficulty in locating the trouble was due to the fact that when a flash-over would occur and throw the synchronous converter out of synchronism they could be immediately brought to voltage, synchronized, and loaded again without giving any evidence of the cause of the trouble. Sometimes the synchronous converters would be thrown out a number of times in a day from this cause, and again they would run for one or two days without any trouble. The cause of the trouble being determined, it was easily remedied by turning the commutators down until the mica and copper segments were even.

In the summer and fall of 1902 all of our synchronous converters were moved to the Post street station, which had just been completed, and we now have in this station nine 500-kilowatt synchronous converters, five of which are 550-volt, three-phase, the other four being 250-volt, two-phase, which are used on the three-wire lighting system. As stated previously, each synchronous converter is connected to its own bank of transformers, the transformers for the 500-volt synchronous converters being connected on the Scott system, transforming from two-phase to three-phase.

The power purchased from the Snoqualmie Falls Power Company is also delivered to this station, making it a combined generating and substation. The synchronous converters operate equally well from the steam-driven generators in this station without the use of special inductance coils as they do from the transmission lines, the only exception to this rule being when the steam-driven generators were operating considerably below their normal speed, say 114 revolutions per minute, their normal speed being 120 revolutions per minute. The action of the synchronous converters when run from the steam-driven generators at this reduced speed seems to be a tendency to slow down every time the engines pass their centres, which produces a very noticeable effect on all incandescent lights supplied from the generators and lighting synchronous converters. This trouble is caused by the irregular angular velocity of the prime movers and can not be considered as synchronous converter trouble. In no case has this caused any trouble other than the effect on the incandescent lamps, even when the speed of the generators would fall as low as 110 and 112 revolutions per minute. As stated before, this effect entirely disappears when the generators are running at their normal speed.

During the last eighteen months the transmission line troubles have been very much less than they were before, and the troubles with the synchronous converters have practically disappeared. As the grounding of the neutral point of the secondary winding of the step-down transformers prevents the synchronous converters from flashing-over at the commutators when line trouble does occur, and various other improvements have been made in the transmission line, we have not had any more trouble with these synchronous converters than would be had with an equal number of direct-current generators of the same capacity.

Having the two sources of supply in the same station, where all of the synchronous converters are located, it has been necessary to operate some of the synchronous converters from the steam-driven generators and some of them from the power supplied by the Snoqualmie Falls Power Company, all synchronous converters being operated in parallel on the direct-current side. This combination is used with both types of synchronous converter, the pressure of each synchronous converter being controlled by Hartford regulators. This arrangement serves to steady the pressure variations caused by the fluctuations of the street railway load, and the results are very

much more satisfactory for smoothing out the load, than when all synchronous converters are operated from the same source of supply.

As to care and attention necessary for synchronous converters, it is substantially the same as that required by direct-current generators of the same pressure and capacity. The commutators require sandpapering about once a week. Occasionally a commutator will require sandpapering twice in one week. No. 2½ sandpaper is used to bring the commutator to a smooth surface, and it is then finished with No. 1 sandpaper. A small amount of oil is used on each sheet of sandpaper to prevent the dust from flying. It is very bad practice to saturate sandpaper with oil for use on a commutator, as the excess of oil will form a paste with the copper dust that will be forced into the mica, if the mica is as soft as commutator mica should be. The excessive use of oil is especially bad if there happens to be a number of mica segments in a commutator that are not uniformly even with the copper segments. Very good results are obtained by spreading the oil evenly over the sandpaper, then absorbing the greater portion of it with clean waste, leaving enough to prevent the copper dust from flying, but not enough to form a paste.

We have tried for a long time to get a carbon brush that would be satisfactory, and we think that we have found one. In the meantime we have found a great many that were not satisfactory, the average life of a set of carbon brushes being from three to six months. We have a set of brushes in a synchronous converter that were put in on May 28, 1904, and they are about half worn out. The wear on this commutator has been very small also. We have a set of brushes in another machine that has been in use since February 23, and the wear on these brushes was found to be about 3/16 of an inch when measured to-day. The brush just mentioned is a medium-soft brush with a good deal of graphite in it. Pure graphite brushes are not at all satisfactory for synchronous converters.

National Association of Manufacturers.

The proceedings of the ninth annual convention of the National Association of Manufacturers, held at Pittsburg, Pa., May 17, 18 and 19, 1904, have been received. This volume contains a number of addresses and reports of committees on many topics of interest to manufacturers.

BOILER-HOUSE ECONOMIES.[1]

BY REGINALD S. DOWNE.

The problem is to deliver a unit of electricity at the station bus-bars, with the minimum number of pounds of coal, and this question is the most difficult one the engineer has to face in the power-house, but the one most likely to give the best money return for the time expended on it. Coal in some cases amounts to fifty per cent of the total cost. In a paper read by Mr. A. S. Giles in January last, before the Manchester section of the Institution of Electrical Engineers, a table compiled from data supplied by the chief engineers of a large number of central stations appeared, giving particulars of coal consumption, load-factor, etc. The figures show that non-condensing stations, with moderate load-factor and low-priced slack, consume 6.5 pounds per unit generated, whereas there are condensing stations with similar priced slack and higher load-factor consuming ten pounds and upward. Broadly speaking, the only conclusions one can arrive at after carefully studying the table, is that the stations with the largest output and highest load-factor appear to give the best results, and that the other contradictory figures must be due to local or special conditions unknown to engineers.

A central station should be run on a money basis, and all the conditions carefully studied when the layout of the plant is decided upon. Each separate station has to be dealt with on its merits, and the measure of success is the net saving in the coal bill at the end of the year. The great majority of stations burn bituminous slack, costing from six shillings to twelve shillings per ton delivered in the bunkers. Where the railway rate is high and smoke conditions stringent, Welsh coal is used; in a few cases where it is available, smudge or low grade fuels are burned. This point is entirely settled by local conditions. Assuming bituminous slack is used, how many pounds ought to be considered the maximum necessary to generate a unit of electricity?

In a well designed condensing station, with economizers and superheaters, and having a load-factor of not less than fifteen per cent, in the author's opinion, with the experience at present available, it ought not to exceed five pounds. This quantity of coal should cover all the losses between the furnace and the engine. Several private industrial plants are now generating a unit of electricity with three pounds of cheap slack. No comparison, however, can be made between the coal consumption of private plants and public supply stations, the nature of supply being totally dissimilar. The results obtained are excellent, but under the same favorable conditions one could do better.

Before this problem can be dealt with, it is necessary to know where the losses are taking place. Are they due to low boiler efficiency, steam range losses, excessive steam consumption of engines, or all three? To enable this to be ascertained it is necessary to have a rigid weekly analysis of units generated, together, with coal and water used. In most works completed quite recently, provision has been made for these measurements, and it is possible to have a daily analysis which enables a close check to be obtained, and any discrepancies to be immediately looked into. A number of stations of earlier date are not so well provided in this respect. It is, however, possible for all to obtain the weekly consumption of coal, and thereby calculate the pounds of coal per unit generated. The measurement of water, unfortunately, is not such a simple matter; in many cases where the supply is not obtained from the town's mains it is not possible.

The various directions and means through which one may still hope to effect a further reduction in our coal consumption are as follows: (1) the influence of output and load-factor; (2) bonus system for firemen; (3) superheating; (4) mechanical stoking and forced draught; (5) fuel analysis; (6) analysis of flue gases; (7) auxiliary plant; (8) feed-water purification and heating; (9) prevention of radiation.

The stations having the largest outputs and the highest load-factors show the best coal results. The coal bill of a station in its earliest stages, before the output has reached a reasonable figure, is often abnormal, owing to its being ready to supply before there is much demand. The conditions are not favorable to economical running, as the fuel required for banking, keeping steam on ranges, etc., is out of proportion to the output. The effect of a bad load-factor is more pronounced in the boiler house than in the engine room. Diagram 1 shows Southport curves of load-factor, output, and pounds of coal per unit generated for the year 1903-4.

With graduated sizes of units it is possible to run the generating plant in a

[1] Abstract of a paper read at the meeting of the Incorporated Municipal Electrical Association, of Great Britain.

fairly economical manner. A standing engine does not waste coal. It is generally admitted that under ordinary working conditions the radiation from a boiler amounts to from five to ten per cent. If we work a boiler only at half its power the amount of radiation will still be the same, for the steam temperature is not

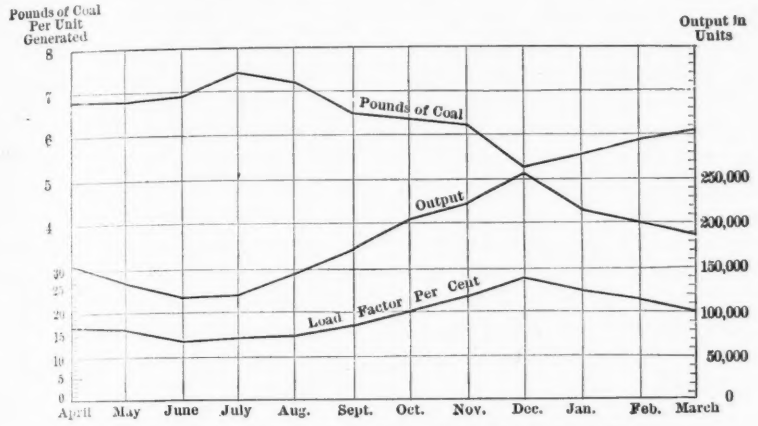


DIAGRAM 1.—RELATION BETWEEN COAL, OUTPUT AND LOAD-FACTOR.

altered, but the ratio of loss by radiation to heat put into the boiler is doubled. It appears, therefore, conclusive that the number of boilers under steam should be kept to the minimum possible, and some method of assisted draught fitted to help us over the peak of the load.

The author thinks it will be admitted that with the class of slack usually burnt, under natural draught, the boiler duty is much lower than the maximum; in many cases the number of boilers under steam could be reduced twenty-five per cent. The station with which the author is connected has Lancashire boilers, and the coal required for lighting and banking fires has been found in the winter months to amount to between five and seven per cent of the coal consumed. There was a difference of two per cent in economy between banking fires on the eight-foot six-inch boilers and allowing fires to die out on the seven-foot boilers, and *vice versa*. A considerable amount of coal may be saved by finding out what banking conditions are most suited to the boilers at different periods of the year.

The personal factor in the form of the fireman has the greatest influence on the reduction of coal costs, after output and load-factor. In a test quoted by Mr. Bryan Donkin, four good stokers were put to fire the same boiler—a two-flued, thirty-foot Lancashire—under the same conditions. There was a difference between the most and least expert of twenty-three per cent in capacity and eighteen per cent in economy, a saving of £7 to £8 per week, with coal at ten shillings per ton. All raw material from which there is no valuable by-product passes through the hands of the fireman. As a rule he does his best, *i. e.*, with a fluctuating load he draws a fairly straight line on a recording steam pressure chart. He knows that the less coal he throws on, the less manual labor he is called upon to perform; he may also have a conscientious idea that by economizing coal he is husbanding the national resources. Generally speaking, beyond that he has no incentive to economy, and provided he keeps a steady head of steam is not interfered with. The man who actually burns the coal is the one who can effect the economies.

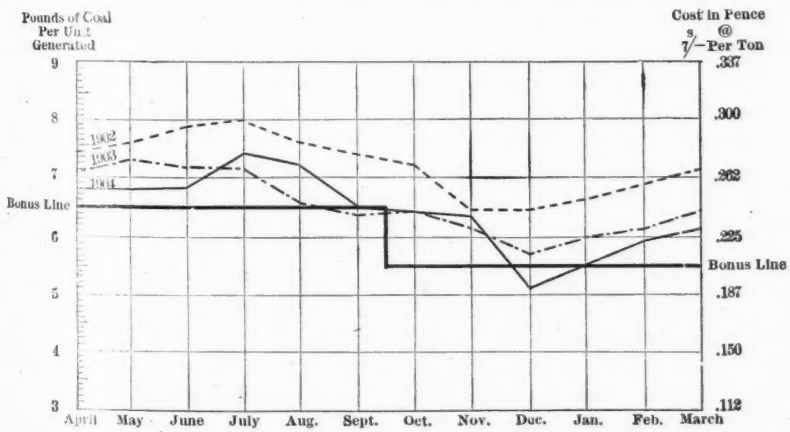


DIAGRAM 2.—BONUS SYSTEM FOR FIREMEN.

When the managing engineer has convinced himself that there are no leakages through the brickwork, when the dampers are easily accessible, draught gauges have been fitted to the chimney and each boiler, and a CO_2 recorder has been fixed, he has done all that can possibly be foreseen, and the rest must naturally be left to the leading firemen. A pecuniary incentive is a great help toward reducing the coal bill. If a central station has not reached what it considers its minimum coal consumption, it is worth while paying at least two shillings to save twenty shillings worth of coal, which it could not otherwise do. It would be interesting to know what results have been obtained by this means. At Southport a coal bonus has been recently introduced, and the following particulars have been added, as they may be of interest to the members:

The present contract price of coal is seven shillings per ton, delivered in the bunkers.

The approximate number of units generated per annum = 2,327,600.

The average number of units generated per week = 44,800.

A saving of one-tenth of a pound of coal per unit generated on the average weekly output = 4,480 pounds = 2 tons, worth fourteen shillings.

Per month of four weeks = £2 16s.

The bonus is divided among the four leading firemen, and is distributed monthly.

It has been fixed at one shilling per week per fireman for each tenth of a pound of coal saved, *i. e.*, for every fifty-six shillings' worth of coal saved sixteen shillings, or 28.5 per cent, is given as bonus.

The pounds of coal below which a bonus is given has been fixed for the next financial year at 6.5 pounds for the summer months and 5.5 pounds for the winter months. If we have to pay more for our coal the saving per ton is proportionally greater. Diagram 2 shows the bonus line at present fixed, and the pounds of coal consumed for each month during the past three financial years, the load-factors being 14.22, 15.31 and 14.49 respectively.

No practical difficulties are experienced

by using a moderate superheat up to 500 degrees Fahrenheit. The author has superheaters fitted in the downtakes of all his Lancashire boilers, and has been able, by adding firebrick combustion chambers, to raise the temperature of the steam leaving the superheaters from eighty degrees Fahrenheit to 150 degrees Fahrenheit. Superheaters fitted in this way give a fairly constant degree of superheat, and require practically no attention. A consideration of the various types of superheaters is outside the scope of this paper; but the author is of opinion that where a high superheat of constant temperature is required (as in pure turbine stations) separately fired superheaters would be preferable.

The following figures were obtained at Southport on two eight-hour tests carried out on a 254 indicated-horse-power horizontal Musgrave-Corliss condensing engine, supplied with steam from a seven-foot by twenty-eight-foot, hand-fired Lancashire boiler, with and without a Musgrave superheater:

	Without Superheater.	With Superheater.	Saving per Cent in Favor of Superheater.
Water per i.h.p. per hour....lbs.	16.30	13 58	17
Water per unit. .....lbs.	29.27	24.24	
Coal per i.h.p. per hour ....lbs	1.80	1.60	16
Coal per unit.....lbs.	3 40	2.86	

Average superheat at engine, 85 degrees Fahrenheit.

At the time of this test a ring steam range was in use, which has since been discarded; a similar test if taken to-day would not show quite the same saving.

To what extent does mechanical stoking influence the coal consumption in central stations? Makers' tests do not help much, as they are not carried out under every-day conditions. In a large power-house having modern coal-handling plant, mechanical stokers undoubtedly save labor, and where the load-factor is high give economical results. In the class of station under consideration, *viz.*, that having a total plant capacity not exceeding from 4,000 indicated-horse-power to 5,000 indicated-horse-power, mechanical stokers are usually employed to enable bituminous coal to be burned with a minimum of smoke. Where the coal has to be thrown into the hoppers by hand there is no saving in labor, and it is doubtful whether any economy can be shown over hand-firing when the interest, repairs and cost of running are taken into account, while on the other hand there may be obvious disadvantages.

With but few exceptions natural draught is depended upon for the combustion of fuel. Is it possible by adding induced or forced draught so to increase the evaporation and economy that after paying all charges there would be a saving that would be worth obtaining? A chimney is a rough-and-ready way of inducing the air to flow into the furnaces with sufficient velocity to cause the fuel to burn; it has the merit of being absolutely reliable and the upkeep is nil. Energy must be expended in bringing the air to the coal, but as a chimney may require twenty per cent of the heat units in the coal, this work may be carried out much more efficiently by other means.

The apparent advantages of forced draught are: (1) the steaming power may be increased thirty to forty per cent without injury; (2) higher temperature of combustion, giving a higher evaporative effect for the fuel; (3) air supply under control.

Perfect combustion is of far more importance, both as regards the efficiency of a boiler and the power to be got out of it, than is—within limits—either the amount of heating surface or its arrangement. The furnaces usually fitted by boilermakers are only suitable for burning anthracite coal or coke. As the majority of boilers burn bituminous coal, the efficiencies are extremely low, but could be raised if the furnaces were designed to suit the class of fuel burned. In a coal containing over ten per cent of volatile hydrocarbon, a high temperature in the combustion chamber (approximating 1,100 degrees Fahrenheit) is absolutely necessary for combustion. In most furnaces, when the gases have distilled they immediately come in contact with water-cooled plates, and are reduced in temperature before combustion takes place. Until the temperature of combustion is raised sufficiently high, the thermal efficiencies of boilers burning this class of fuel will remain in the neighborhood of fifty per cent.

It is essential that the quality of the coal used should not be frequently changed, otherwise firemen can not obtain the best results. How can one ascertain that the quality of coal contracted for is being delivered? Some engineers argue that by buying the cheapest slack obtainable in the district, any deviation from the contract must be in their favor, but this method of procedure can not always be recommended. Calorimeter tests of small quantities of coal, although fairly comparative, are not of much commercial value, because the thermal value of bituminous fuel is augmented by the hydrocarbons, a large proportion of which escape up the chimney without parting with their heat. The calorific value of some soft bituminous coal is equal to that of hard South Wales coal, but in practice the evaporation is much lower. If we obtain the percentage of moisture under similar weather conditions by drying a known weight of slack, and also ascertain the percentage of ash, it is possible to keep a reasonable check on the deliveries. In the author's opinion, evaporation tests made under similar conditions give the best practical results. Where a contract is placed with a colliery, fewer deviations in quality are to be expected than where supplies are obtained from a coal merchant or colliery agent; where the colliery works only one seam of coal the conditions are even more favorable.

For a complete analysis of the exit gases from a boiler it is necessary to know their chemical constituents, temperature and draught. This information enables the engineer to reduce the loss up the chimney to a minimum; apparatus for carrying out these tests is now available. To obtain the greatest boiler efficiency the excess of air must be kept as low as possible, and this can only be ascertained by individual tests, and depends upon the quality of coal and the draught available. Every pound of air which passes through the boiler in excess of the theoretical quantity represents a dead loss, as this air has to be heated up from the temperature of the atmosphere to the temperature of the exit gases. To obtain perfect combustion of the fuel, as much oxygen as possible should combine with the carbon to produce carbonic acid. For practical purposes, the amount of carbonic acid produced is an index to the state of combustion. Under theoretical conditions without excess air, nineteen per cent CO_2 would be produced, but in every-day work one might with reasonable attention obtain twelve per cent CO_2 with an exit temperature of 600 degrees Fahrenheit. The difference between eight per cent and twelve per cent CO_2 represents a loss of 8.5 per cent of the fuel burned.

Many works have recently fitted up recording apparatus to ascertain this percentage, and in most cases the results have been eminently satisfactory, and have well justified the outlay. It is possible to connect the apparatus to each boiler in turn, and by reducing the air leakages, altering the thickness of fires, etc., to raise the average percentage of CO_2 considerably. When boilers are shut down

under natural draught, there is always considerable air leakage into the main flue even when the dampers are closed. Sliding dampers require to be an easy fit in their frames, but in most cases this is overdone; an improvement on the usual type of damper might be easily fitted. The brickwork round damper frames is difficult to inspect; generally on being opened up it is found to pass cold air at every joint. This air has a considerable cooling effect on the gases; it decreases the draught, and lowers the economizer efficiency.

The author has had one form of CO_2 recording apparatus fitted in his boiler house for the past eight months, and has found it extremely useful. When first installed it was impossible to get more than from two to three per cent CO_2 from certain boilers; on tests he has since obtained fifteen to sixteen per cent as a maximum, but the average daily running works out about ten per cent. Two boilers, even after the brickwork had been thoroughly overhauled, would not give more than three per cent CO_2. On further investigation being made it was found that there was an opening at the back dead-plates just behind the bridges, measuring thirty inches by three inches; this was a drastic remedy of the boiler-makers for smokeless combustion. On bricking up these openings the CO_2 was equal to that given by the other boilers, and they naturally gave a better duty.

Mechanical stokers, economizer scrappers, coal elevators and ash conveyers are now generally electrically driven. Most stations, however, still have steam feed pumps which are notoriously inefficient, and may require from two and one-half to three and one-half per cent of the steam generated. With a careful subdivision of electrically driven feed pumps this may be reduced to one and one-half per cent. The first cost of the pumps is greater, but after meeting all charges there is a distinct saving, and they are as reliable as any other type of feed pump. It is, however, advisable to have a steam pump as standby in the event of any local or other failure of the supply.

It is now well known that scale does not materially reduce the efficiency of a boiler, but it seriously increases its wear and tear, whereby its life is considerably reduced; it also endangers the safety of boilers. The same remarks apply to coatings of grease due to feeding the boiler with water containing condensed steam from the engine. It is highly desirable to remove every trace of grease from the feed water. This can not be done by filters; the only efficient method is to add mineral matter in solution to the condensed water, and then to cause precipitation by chemical means. In every case where the water is treated it should be done externally before entering the boiler. For economical steaming a boiler should be clean inside and out, because the transmission of heat is rendered easier and the evaporation is increased.

It is a generally accepted fact that no economy can be obtained by raising the temperature of feed water except by heat which would be otherwise wasted. Is it possible by having separately fired feed boilers in series with economizers, to put the water into the boilers at the same temperature as the steam and so obtain more duty per boiler and reduce the number under steam, thus effecting a saving in coal? The true function of a boiler would then be steam raising, and not feed heating in addition. Under existing methods the limit to which heating can at present be carried is to have an exhaust heater in the path of the steam, on its way from the cylinder to the condenser, and in series with it a heater which will utilize the exhaust steam from the auxiliary engines, the water afterward passing through a third heater in the form of an economizer. The temperature to which the feed water can be raised has a decided bearing on the subject, as the economy resulting from raising feed water from 150 to 250 degrees Fahrenheit is ten per cent.

When the boilers and piping have been covered with the most suitable material, it is necessary to have it periodically examined and repaired, as it is usually of a perishable nature. Where it is enclosed in a metallic envelope much waste may be caused if there is contact between the piping and the shield, which may be at nearly the temperature of the steam. Condensation may be reduced one-half if the valve bodies and flanges are covered. The joint itself may be left exposed, but with superheated steam there is little trouble from leaky joints, if the ranges are well drained.

Perfect combustion of fuel can not be obtained in any form of boiler, but it ought to be possible to considerably raise the low thermal efficiencies at which most of them are working at the present time. The two essentials are: the highest possible initial temperature in the combustion process, as the heat transmission between the water and the hot gases is directly proportional to their difference of temperature; and a high temperature in the combustion chamber, so that the volatile gases are not cooled down before combustion takes place.

The author has carried out a large number of evaporation tests at different rates of combustion, and with different forms of combustion chambers, on hand-fired seven-foot by twenty-eight-foot Lancashire boilers. The evaporation per pound of coal from and at 212 degrees Fahrenheit varied from 6.62 pounds to 7.17 pounds. Coal burnt per square foot, from thirty-three to seventeen pounds. Evaporation, from 5,250 pounds of water per hour to 3,900 pounds, and the superheat from 151 degrees to eighty degrees Fahrenheit. One boiler is fitted with steam blowers. On test 5,400 pounds of water per hour were evaporated. After deducting the steam taken by the blowers, the evaporation per pound of coal was only 6.21 pounds.

On a special test it was found that the steam jets when giving a draught equal to five-eighths inch in the ashpits required 340 pounds of steam per hour, equal to six per cent of the steam generated. The fine ash made by the ordinary furnaces amounting to three per cent of the coal burned, approximately 200 tons per annum, is dealt with by this boiler; it was found to have an evaporation value equal to one-half that of the slack. Under the conditions stated in Southport they obtained an average evaporation of seven pounds of water per pound of coal, having a calorific value of 13,000 B. T. U. Their average combined boiler superheater efficiency, therefore, is only fifty-two per cent.

The Opportunities for Electrical Household Utensils.

To the Editor of the Electrical Review:

If it is true that a temporary calm has fallen on the production of standard lines of electrical apparatus, it may be opportune to turn attention to the field of domestic application, which would rarely sleep if thoroughly awakened, for surely this field offers a lucrative as well as interesting opportunity. Comparatively few households enjoy the luxury of just pushing a button to put their chafing-dish on a business basis, or heating their shaving water or boiling eggs, or getting their families into liquid hot water whenever they feel disposed, without the discomfort of a Turkish bath temperature in the boiler room of the household. Most of us are progressive, or at least ready to move along paths of least exertion, providing the cost does not involve too much exertion. One of the difficulties in the popular use of electric heating is that convenience and cost are strongly unionized and too readily follow each others proportions.

F. A. Barron.

Schenectady, N. Y., July 27.

The Simmance-Abady Photometer.

Messrs. Simmance and Abady have reprinted from the proceedings of the Physical Society of London, a paper read by them on December 11, 1903, on the Simmance-Abady "flicker" photometer. An abstract of this paper follows:

The photometer is of the alternating-light type, recently called in France "scintillation photometer," but more generally known in England and America as "flicker." According to the authors, the essential rules to be followed in the construction of a successful "flicker" photometer are as follows: the light effects must be in juxtaposition without any apparent division line, and must move, oscillate or rotate so that the point of juncture of the rays of the two lights passes and returns entirely across the vision field. Any hiatus or longer excitation of one than the other biases the result. The observation surface or surfaces upon which the light rays fall must be at exactly the same distance from the eye, at exactly the same angle in relation to the line of sight, and must be of pure white, such as is afforded, for example, by a clean chalk, plaster of Paris, magnesium carbonate or barium sulphate. Any tint affects the accuracy of the result. The observation surfaces must also, in turn, occupy the field of vision. An apparent movement or optical illusion does not afford accurate results.

The method of reading with this photometer resolves itself into a question as to whether the disc of light seen through the sighting tube is moving or is motionless.

As to the causes of the phenomenon, they are no doubt simple on the surface, but may be more complex when closely considered. The pupil of the eye can not adjust itself to the rapidly changing intensities, and when the balance is struck, the light, being unchanging and motionless, permits of pupil adjustment. The colors then blend by persistence of the impression, but should the intensities again change, this retentive sense is dulled by the anxiety of the nerves controlling the pupil orifice to perform their work, an endeavor, however, frustrated by the rapid change. It appears certain that an abnormal excitation of the nerves controlling the diaphragm has the effect of lessening the susceptibility of the retina and retention of impressions, whether this excitation is caused by glancing at a bright light or by gazing too long at the changing disc of the photometer. When the nerves are overstrained in this way the "flicker" does not disappear at all, in many cases, although the point of equality of intensity is always unmistakable. Thus, in using the photometer, it is suggested that the instrument shall be moved along the bar rather rapidly, the while observing the disc through the sighting glass. The "motionless" point will then be apparent at once, and by a little practice (which in this, like everything else, generates confidence) an operator will swing the disc box into its balance of intensity without an effort and without giving the sensitiveness of his retina time to suffer from the numbing effect of the flickerings or throbbing.

The accuracy of the photometer for colored lights is confirmed by the following experiments:

Two standard lamps of exactly the same power were used, one at each end of the photometer bar. A colored glass screen was interposed, to intercept the rays from one light, which was then measured against the unscreened light. This gave the value for one colored screen. A second color was then substituted for the first and its value measured against the same unscreened light. Thus the following values were obtained:

(*a*) Unscreened lights.

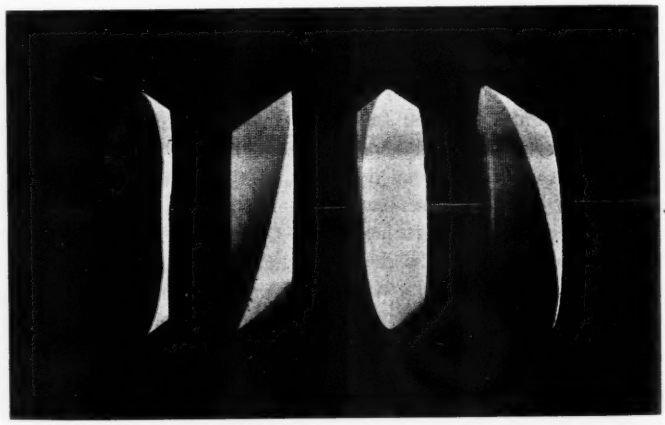
(*b*) Candle-power of one light screened with one color.

(*c*) Candle-power of one light screened with the other color.

The Simmance-Abady photometer consists of a wheel of a white material with a specially shaped periphery, which wheel is caused to revolve before an eyepiece by means of a suitable motor. At right angles to the line of sight and parallel with the axis of the revolving wheel are the two lights undergoing examination, the rays of which fall upon the shaped periphery of the wheel, enabling the effect of each light to be seen in turn through the eyepiece.

The accompanying illustration shows the four cardinal positions of the wheel in sequence, illuminated by two unequal lights. It will be seen how the light effects travel across the line of vision and alternate as the wheel revolves.

The revolving wheel has its periphery formed by two equal conical surfaces or other surfaces of revolution. The axes of the two conical surfaces are each parallel to the axis of the revolving wheel, at exactly equal distances therefrom, and the three axes lie in the same plane. The vertices of the conical surfaces are at equal distances on opposite sides of the line of sight. In manufacturing, the wheel is first made as a disc of uniform thickness. It is then chucked in a lathe eccentrically, and a straight line motion being given to the cutting or grinding tool, the conical surfaces are generated. The wheel is then rechucked eccentrically on the opposite side, and the other conical surface is generated by the cutting or grinding tool, having the same straight-line motion as before. The result is that the periphery of the wheel has its two sides uniformly sloping at equal opposite angles, while the ridges of intersection of the two surfaces cross and recross the axis of vision during each revolution. This wheel is driven with a motion communicated from a suitable motor, either spring, electric, or any form which will produce absolutely regular motion—and at the same time afford means for easily adjusting the speed. In the instrument shown an expansion governor is utilized driven at a carefully arranged ratio speed, but the connection between the spindle carrying the governor and that carrying the reflecting wheel is not rigid, but affected by means of a coiled spring. The



THE SIMMANCE-ABADY "FLICKER" PHOTOMETER.

most perfect accuracy of centering is essential. Outside the box are the remontoir, stopping and starting lever and speed adjustment, a spring motor being used.

The peculiar shape of the reflecting wheel affords means for using it in manners quite impossible in any other form of color photometer, that is to say, it may, at will, test lights at various angles from the horizontal. Having found the careful cutting of the angles of the wheel so vital it necessarily follows that when lights out of the horizontal are being tested, the box containing the wheel must be just as carefully turned on its axis for preserving the arranged conditions. A double quadrant scale (one scale being numbered at double the actual angle) and a small sighting or view-finding attachment enable the angle formed by the horizontal of the one light and the altitude of the other to be accurately ascertained, and the box to be placed at the correct angle of bisection.

New Michigan Electrical Society.

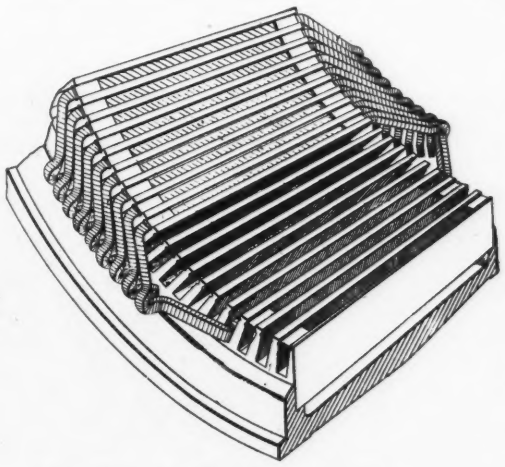
A meeting was held on July 21 at the Hotel Pantlind, Grand Rapids, Mich., for the purpose of organizing the Michigan Electric Lighting Association. Twenty-five members were present at the inaugural meeting, and the society will be made up of general managers and superintendents of electric lighting and power plants in the state of Michigan. The association is similar to other lighting associations formed in the various parts of the country, and is said to be affiliated with the Northwestern Electric Association. The first annual meeting will be held in October, and a committee has been appointed to select a place. The temporary officers elected are E. F. Phillips, assistant general manager of the Detroit Edison Company, president, and F. S. Hubbel, of Milford, secretary.

Wave-Operated Clocks.

Experiments in Paris on wave-operated clocks have proved successful and shown that such a system can be practically operated. A main clock operating an electric contact each second works a relay sending a current into the primary of an induction coil provided with an oscillator. The secondary gives an oscillating discharge for a short time, regular for each second a mast is needed to send the signals. Two kinds of receivers are used, the ordinary wireless and the radio-telephone of the Popoff- Ducrete pattern. The experiment has been successful over a distance of one and two-tenths miles.

A Means for Retaining Armature Coils.

An improvement in coil-retaining means for electric machines has been devised and patented by Isaac De Kaiser, of Wilkinsburg, Pa. In carrying out the invention, a laminated-iron core is securely held in a cast frame and comprises annular sheet-iron punchings having inwardly projecting teeth, between which are slots for the reception of coils. The sides of the teeth adjacent to their free ends are provided with grooves, which extend inwardly from the ends of the core a short distance only; the beveled edges of small fibre strips are fitted tightly into these grooves after the coils are in place. If the grooves extended entirely across the core, the cross-sectional area of the teeth would be materially reduced, causing a higher flux density at the ends of the teeth for the same winding on the core than would be produced if there were no grooves in the teeth. Such construction has been found to be objectionable. By the present invention, the cross-sectional area of the ends of the teeth is not reduced except at the extreme ends of the core, and at the same time a simple and easily applied means is provided for retaining the coils in proper position.



Coil-Retaining Means for Electric Machines.

Model Library at the Fair.

The board of directors of the St. Louis Public Library has opened a model library in the Missouri Building for the use of the public, and especially of those employés of the exposition who spend the greater part of their time within the grounds.

One of the many uses to which electricity generated by water power in the mountains of California has been put is the pumping of water for irrigation.

The Telephone Situation in London.

In a recent issue of the London *Mail*, Mr. Herbert Laws Webb, the well-known consulting telephone engineer, makes some interesting remarks with regard to the telephone service of London, England. In London the history of the telephone is a story of collective obstruction and of individual conservatism. In New York neither the authorities nor the public has made difficulties. As a result, there are in New York telephones in a proportion of about one to fifteen of population, and a highly efficient service, whereas in London there are telephones only in a proportion of one to seventy-five of population, and the service becomes daily more difficult to carry on effectively.

The principal reason why London has not yet got an adequate telephone service—although all the machinery is available for providing it—is that it has never been possible to lay down a comprehensive network of wires. One of the most essential features of a city telephone system is the wire plant, and this must be laid out on a broad scale, so that subscribers in all parts may be readily connected to the exchanges, and the various exchanges connected to each other.

The London telephone area is unique. There are 640 square miles to cover—practically ten times as much as New York's telephone area, and eight times as large as the telephone area of Chicago. To lay out a distribution system over this immense area, sufficient to provide a telephone service for several hundred thousand telephone users, is an engineering and financial problem of the first magnitude. A basis of such a system, which can only be effectively provided by means of underground wires, would have been established long ago but for the opposition of the street authorities in London, who have persistently refused to allow underground telephone wires to be laid.

The recent work of the post office in London is an illustration of the cost and complexity of the telephone system of a big city. The post office began work more than four years ago, and up to the month of January, 1904, had spent £1,500,000 on telephone cables and exchanges to serve a comparatively small part of London. There are about 16,000 telephones now connected to the post office system, and although cables have been laid in sufficient number to accommodate many more telephones, still the system so far built serves only a small portion of the London area.

The New Headquarters of the Police Telegraph of the Borough of Brooklyn.

On July 1, 1904, the police telegraph headquarters for the Borough of Brooklyn was moved from 16 Smith street to a new five-story building at 269 State street, Brooklyn. The police telegraph system of the Borough of Brooklyn is probably the most efficient and carefully managed in the United States. Brooklyn has the honor of having led in the abandonment of the Morse telegraph and the inauguration of a complete telephone system for the transmitting of official messages between precincts and in connecting up the police signal-box system with the precinct stations.

No. 269 State street is the police headquarters of the Borough of Brooklyn. In this building, in addition to the police telegraph system, are housed all the high officials of the Brooklyn police department, and in addition to the inter-station service, the police telephone system gives service to all the offices in this building in connection with the main exchange in Brooklyn of the New York & New Jersey Telephone Company.

When the old headquarters at 16 Smith street was abandoned, connection was made with an entirely new switchboard apparatus at the new quarters. This switchboard is of the six-position type, having twenty circuits to each position. The switchboard is equipped with self-restoring drops, and ringing current is furnished by one-quarter-horse-power Holtzer-Cabot motor-generators. In order that there may always be ringing current, the board is equipped with magneto-generators, so that if, for any reason, the street service which operates the motor-generators should fail, the operators at the switchboard would still be able to call all their respective stations.

The wires go into the building through underground conduits, and are connected to terminals on a single vertical terminal strip. From this vertical terminal strip they are fanned out to a distributing rack, from which rack they are led, through a marble fused board, direct to the back of the operating switchboard. Gordon primary cells are used for local transmitter current and for supplying the current to operate the self-restoring drops.

The police telephone system requires fourteen operators, who work in three shifts. The shifts are arranged from 12 midnight to 8 A. M.; from 8 A. M. to 6 P. M., and from 6 P. M. to midnight. The working arrangements are such that each operator in turn occupies that position which requires the most exacting and laborious service. In addition to the operators there are five linemen, one inspector and one battery man.

The system comprises some 600 miles of wire and 480 telephones, of which 390 are in connection with the police signal-box system, and the balance in the precinct stations. The circuits are nearly all on the elevated railroad structure or on poles, but a contract has recently been awarded to the Safety Insulated Wire and Cable Company, New York city, to place all wires underground. The contract calls for an expenditure of $54,000. The work has been started and must be completed within four months. Except in subsidiary ducts running from the boxes to the main conduit, and in some other isolated places, the wires will all be placed in the conduits of the New York & New Jersey Telephone Company.

The police signal-box system consists not only of the telephone apparatus, but also contains a telegraphic registering apparatus which conveys to the proper precinct the desired signal. When the officer opens the box, the registering apparatus is automatically thrown in circuit. Upon a quarter segment there are four indications—"wagon," "telephone," "ambulance" and "fire." In accordance with the signal which the officer desires to send to his precinct, he pulls down the lever until the pointer comes opposite and rests upon the desired signal. If it happens to be box No. 23, and the officer desires to send a signal for the patrol wagon, an audible signal is received at the station, and the signal is also impressed upon the recording tape. After the two dots, followed by three dots have been received, there will be a single dot sent, to indicate that the wagon is required. If the officer wishes to follow up the wagon signal with a telephone message, the indicator is turned to the telephone mark and two dots are received, the telephone at the same time being thrown into circuit. The ambulance call will be indicated by three dots following the box number, and the fire-alarm will be indicated by four dots following the box number.

The police signal boxes are connected individually to the precinct in which they may happen to be, and are not connected to the main switchboard at police headquarters. The function of the switchboard at police headquarters is to provide intercommunication between the precinct stations, and to transmit all official messages from precinct to precinct and from police headquarters to each precinct. Each hospital, which has an ambulance service—of which there are nine in the Borough of Brooklyn—has a direct wire to the main switchboard. There is a direct wire to fire-department headquarters, and a gong, located in the operating room at police headquarters, is bridged on to the main fire-alarm signal circuit, this gong ringing all alarms which are received at fire headquarters. There is a direct line to the Bridge police station, a direct line to the coroner's office, six direct lines to the main exchange of the New York &

THE HEADQUARTERS OF THE SUPERINTENDENT OF POLICE TELEGRAPH, BOROUGH OF BROOKLYN.

New Jersey Telephone Company, a direct line to the Borough of Richmond, a direct line to the Borough of Queens, and seven direct wires to police headquarters in New York city.

The entire bureau of police telegraph of the Borough of Brooklyn is in charge of superintendent Frank C. Mason, one of the pioneers in municipal electrical engineering. The telephone system was inaugurated in Brooklyn under his direction, and the recent change from the Smith street quarters to the new quarters in State street was made under his personal supervision, and carried out without losing a call.

SWITCHBOARD, NEW HEADQUARTERS OF THE POLICE TELEGRAPH, BOROUGH OF BROOKLYN.

In connection with the working of the system, it will not be amiss to say a word with regard to the quality of service which is required of the police telegraph operator. The function of the ordinary exchange operator is to connect and disconnect certain circuits, and the efforts required in this service becomes more or less mechanical. It is an entirely different matter with the police telephone operator. Not only must he be a person of great tact, but he must have a knowledge considerably broader than even the ordinary intelligent citizen. The operators are detailed from the ranks, and only men who have had a long police experience and have done considerable desk work can aspire to the telephone service. The police telephone operator must be well informed on all laws relating to the police department, the building department and coroner's office; must keep himself informed on all city ordinances of many years' standing, in addition to being posted on new ordinances. He must have an offhand knowledge of the location of all city and county buildings and departments, various railroad depots, and national, state and county officials. He must answer questions with regard to the location and telephone numbers of important business houses, hotels and telegraph offices; must understand the building laws; must have a knowledge of the fire signals and the location of fire boxes; must have in mind for immediate use the territory covered by the ambulance service of the different hospitals, and, above all, must be able to deal kindly with, and secure all possible information from, the sometimes hysterical person who is communicating a message to police headquarters.

To one who have never before witnessed the work of this department, it is amazing to see the volume of business which is so carefully, quietly and conscientiously carried on. As each message is received it is written down in long-hand on the operator's memorandum pad. This memorandum is, in turn, handed to a bookkeeper, who inscribes it on the universal blotter. The day, hour and minute of each message are written down against the message, and all confirmatory or explanatory remarks in connection with the message are indicated in a wide margin in a different colored ink. A separate blotter is kept for dead animals discovered in the streets; another blotter for missing and lost persons, and another for general messages, such as department notes, transfers and routine conditions. Within one hour it is sometimes necessary to transmit as many as a half dozen messages to every precinct in the city. Some of these messages reach into a hundred words or over. It is a fact, however, that a message of one hundred words can be transmitted to every one of the thirty-nine precincts in less than three minutes. When a message is received which calls for transmission to all of the precincts, each precinct is plugged in consecutively, and as the

officer in charge confirms the signal, the next one is called. In this way the roll of all the precincts is called, and when every one has replied, the message is spoken into the transmitter and received by each one of the precinct attendants simultaneously. After the message has been transmitted the roll is called, beginning at the lowest number and going to the highest, receiving a confirmatory signal from each attendant, with his initials. This message is written into the blotter, and the confirmatory signals and initials appended, so that there is always corroborative evidence that the work has been faithfully carried out.

Technical Newspaper Men Inspect the New York Subway.

On Monday, August 1, a party of representatives of the technical press was conducted through the New York subway, through the courtesy of Mr. John B. McDonald, assisted by Mr. Harry B. Reed and Mr. C. P. Reed. The party started at one o'clock from the City Hall station, and the first stop was made at Fourteenth street, and the second stop at Twenty-third street.

The trip was made on a flat car, upon which seats had been erected, pushed by a small locomotive. The car ran on one of the express tracks which have been completely laid down and are ready for through running. Under express conditions the trains will reach Fourteenth street from City Hall in a little less than three minutes, reaching the Grand Central Station at Forty-second street in six minutes.

All the members of the party were keenly appreciative of the elaborate manner in which all the facilities have been arranged at the stations, looking to the comfort of the passengers. Ample room is provided for the congregation of even a large crowd, and apparently there will be great ease for the ingress and egress of passengers.

A particular feature of the installation which caught the eye of the technical men was the accessibility of the conduit manholes. The signal system was also carefully explained, and was the subject of discussion.

Shortly before reaching the Manhattan viaduct a violent storm broke out, and this rendered impossible the trip across the viaduct. By reason of this storm it was also impossible to make the trip to the power-house over the exposed portion of the city. The power-house will be visited later.

Among those present were J. R. Dunlap, C. B. Going and H. H. Suplee, editors of the *Engineering Magazine;* C. W. Baker and C. S. Hill, of the *Engineering News;* J. M. Goodell, of the *Engineering Record;* C. B. Poole, of the *American Electrician;* H. W. Blake, of the *Street Railway Journal;* R. V. Wright, of the *American Engineer and Railroad Journal;* F. J. Miller, of the *American Machinist;* F. Hobart, of the *Engineering and Mining Journal;* Angus Sinclair, of the *Locomotive Engineering;* Professor Albert Spies, of *Cassier's Magazine;* L. E. Van Norman, of the *Review of Reviews;* W. J. Johnston and W. Y. Westervelt, of the *Mining Magazine;* W. A. Chater, of the *Pall Mall Gazette;* W. B. Kaempffert, of the *Scientific American;* R. Morris, of the *Railroad Gazette;* Melville E. Stone, general manager of the Associated Press; Charles W. Price, of the ELECTRICAL REVIEW; Charles Warren Hunt, of the American Society of Civil Engineers, and William Bradley, contractor of the boulevard section. Mr. John B. McDonald, the builder of the subway, accompanied the party.

Old Time Telegraphers' and United States Military Telegraph Corps' Meeting.

The twenty-fourth annual joint reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps, will be held at Atlanta, Ga., September 20, 21 and 22. The Piedmont Hotel will be the headquarters. Mr. J. E. Scofield is chairman of the committee on hotels, in care of the Postal Telegraph-Cable Company, Atlanta, Ga.

The following programme has been outlined for the three days of the meeting:

Tuesday, September 20, 10.30 A. M.—Business meeting Old Time Telegraphers' and Historical Association, Piedmont Hotel; 11.30 A. M., business meeting of the United States Military Telegraph Corps, Piedmont Hotel; 1.30 P. M., street car ride to Piedmont Driving Club, where luncheon will be served; 3 P. M., street car ride around the city.

Wednesday, September 21, forenoon—Visiting and shopping by the ladies. Points of interest in the city will be shown by the local reception committee; 3 P. M., barbecue at Cold Springs' Cue Club; take cars at corner Marietta and Broad streets, returning to city about 6 P. M.; 8 P. M., theatre party.

Thursday, September 22, 8 A. M.—Visit to Stone Mountain and Federal Prison; 2 P. M., trip to Lithia Springs, dance and supper, take cars at Union depot, returning 8.30 P. M.

The Ohio Electric Light Association.

The annual meeting of the Ohio Electric Light Association will be held in Sandusky, Ohio, August 16, 17 and 18, 1904. The headquarters will be at the West House. An elaborate programme has been arranged.

The session will be called to order on Tuesday, August 16, at 10 A. M. Following the roll call and presentation of candidates, the minutes of the last meeting will be read, and this will be followed by the president's address.

On Tuesday afternoon, at 2 o'clock, the following papers will be read: "A Day Load as a Factor in Central Station Earning Capacity," L. D. Hoyt; "Notes on the Incandescent Lamp," E. H. Houghton; "Transformer Testing for Central Stations," S. E. Johanneson; "Relation of the Supply House to the Central Station," P. R. Boole.

On Tuesday evening there will be a trip to Cedar Point and a theatre party as guests of the Warren Electric and Manufacturing Company, of Sandusky, Ohio.

On Wednesday morning, August 17, at 9 o'clock, papers will be taken up as follows: "The New Luminous Arc Street System," H. W. Hillman; "Notes on Incandescent Street Lighting," K. C. Randall; "The Important Relation of Electric Heating Devices to Central Stations," H. W. Hillman; "A Symposium on Central Station Heating," by George Haler, Jr., E. F. Gwynn, J. A. Bendure and A. W. Field.

Papers will be read at the afternoon session, beginning at 2 o'clock, as follows: "The Steam Turbine and Its Use," E. C. Crocker; "The Instrument Equipment of a Testing Department," Frank Conrad; "Graded Costs of Electric Supply," M. E. Turner; "Points for Consideration When Purchasing Series Alternating-Current Arc Lamps," G. Brewer Griffin.

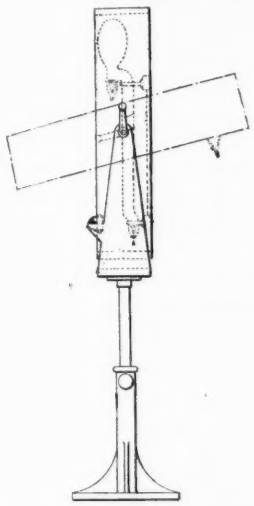
In the evening the delegates will be the guests of the Lake Shore Electric Railway Company on a trolley ride to Ruggles Grove, followed by a launch ride on Sandusky Bay.

On Thursday morning at 9 o'clock, Mr. W. E. Richards will read a paper entitled "Unaccounted-for Current." This will be followed by a paper on "Voltage Regulation—Does It Pay? Why?" by L. G. White. Discussion will follow on the topic, "Joint Use of Poles by Public Service Companies." This will be opened by D. L. Gaskill and John H. Miller. These papers will be followed by the reports of the various committees and officers, and the election of new officers.

Mr. J. H. Perkins, of Youngstown, is the president of the association, and Mr. D. L. Gaskill, of Greenville, is the secretary-treasurer.

Electrical Patents.

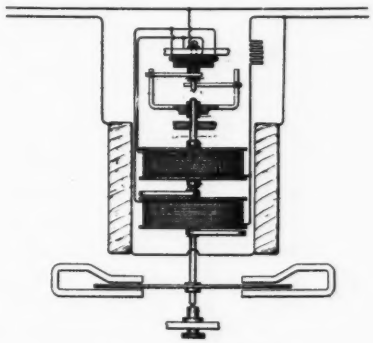
A method of starting gas or vapor electric devices has been patented by Stanwood E. Flichtner, of Englewood, N. J., who has assigned the patent to the Cooper Hewitt Electric Company, a corporation of New York. The invention relates to a method of starting gas or vapor electric apparatus in which electrodes of mercury or other liquid-conducting material are located one above the other in the normal operation of the device. It has been customary to start these devices into operation by impressing upon the terminals of the apparatus or through a starting band or other equivalent a higher potential than that on which the apparatus is designed for operation after which the source of high potential has been removed



METHOD OF STARTING GAS OR VAPOR ELECTRIC DEVICES.

from the circuit and the device operated on a certain lower normal potential. The inventor has devised means by which the use of a source of higher potential may be dispensed with and the apparatus started with the normal operating current applied to its terminals. The mode by which this is accomplished may be briefly described as consisting in tilting the apparatus so that a portion of the mercury or other liquid conductor residing in the receptacle containing the lower electrode may be spilled into the receptacle for the upper electrode and the excess be restored to the lower electrode receptacle in a stream, while the current is applied to the terminals. It is found when this is done that the stream of falling liquid will constitute a good conductor between the terminals and that when the liquid, acting under the influence of gravity, begins to form itself into a spray near the bottom of the falling stream the current will pass from the mercury surrounding the lower terminal of the apparatus to the end of the solid portion of the stream and, as the latter turns into spray, will follow up the solid portion of the stream until all the liquid which it is designed to spill over has passed out of the upper receptacle, whereupon current will flow from the lower electrode to the upper. Sufficient mercury or other conducting liquid is retained in the upper receptacle to constitute an electrode for the apparatus.

Albert Peloux, a resident of Geneva, Switzerland, has assigned to General Electric Company, a corporation of New York, a patent recently granted to him in this country on an electric meter. The circuit in which the consumption of energy is to be measured includes two mains, in one of which are located, in series, two large current coils which are placed with their axes horizontal and coincident. The rotating member of the meter comprises a vertical shaft upon which a pair of magnetizable members are rigidly secured. The shaft is supported in suitable bearings. The magnetizable members are similar in construction and consist of sleeved portions which surround the shaft, and pairs of arms which extend perpendicularly and oppositely from the sleeved member. The members are staggered with respect to one another, and are placed one above the other. At the lower end of the shaft is the usual disc which, in conjunction with magnets, operates in the ordinary manner to retard the rotation of the shaft. Surrounding the sleeve portions of the members and located between the oppositely extending members are two coils, connected on one side to one main through a line. The lines leading from the other side of these coils are bifurcated and are connected to the conductor portions of the commutator or current-introducing member. This member comprises a cylindrical portion of insulating material in which is axially inserted a rod formed of good conducting material, preferably silver. The upper end of this rod is electrically connected to the main. Above the cylindrical portion is another cylindrical portion of insulating material and of considerably large diameter. This portion is integral and coaxial with the other portion, the rod passing through both portions. The conducting portion of the commutator consists of four fine silver wires which are embedded in the block of insulation. The wires extend radially from points at the periphery of the enlarged portion for some distance and then extend downward in a direction parallel to the axes of the cylinder and are partially embedded in grooves formed in the periphery of the block, having a portion exposed in order to contact with brushes. The wires are symmetrically disposed with reference to the block, occupying positions ninety degrees apart. The bifurcated conductors leading from the coils are connected to the opposite pairs of wires. The brushes are adjustably mounted on a frame or carrier. The framework of the carrier consists of a horizontal portion and two vertical portions to which the brushes are attached. The carrier is mounted on the shaft at its upper end and is insulated therefrom by a suitable bushing. One of the brushes is adapted to bear upon the surface of the cylindrical portion, while the other bears against the projecting lower end of the rod. As the shaft rotates, therefore, a circuit is made alternately through the coils twice during each revolution of the shaft. The passage of current through the coils magnetizes the members. These members when magnetized tend to set themselves parallel with the magnetic field passing between the coils. This rotates the shaft and as one of the members turns into the position occupied by



ELECTRIC METER.

one of the magnetizable members the circuit is automatically broken through the coil which energizes that member and is at the same time closed through the coil which energizes the other member, thus keeping up the rotation.

Some New Safety Devices.

A number of new devices aiming toward a greater degree of safety to passengers have been installed by the Berlin elevated and underground electric railway. A short-circuiting switch, under control of the motorman, grounds the current and blows the fuse at the power-house in case of accident. A portable bar, provided with insulating brushes, to be placed across the third and return rails accomplishes the same result. The tunnels are lighted by two independent circuits, at fifty-two-foot intervals, and have fire extinguishers about 100 yards apart. In addition, each station is connected with the fire department by a direct wire and has an ample number of hydrants.

Reviews of Current Engineering and Scientific Literature.

Motor Car Accidents.

Recent accidents to automobiles in England have drawn attention to certain defects in construction which have resulted from the desire to decrease weight to the lowest point. In the evolution of the mechanical design, empiricism plays a large part, and trial and error often determine the final proportions much more than calculation. In this respect the automobile does not differ from any of its predecessors, and, if anything, the problems are in some ways more complex. However, it does not require much consideration to show how serious must be the nature of the stresses imposed on the wheels of such vehicles when turning corners at a high rate of speed. The plane of motion in which the wheels are running suffers serious angular displacement, and the force required to effect this has to be applied at the circumference, and in a direction in which the wheel has lost rigidity. The low centre of gravity enables automobiles to turn corners with greater ease than ordinary vehicles, but the stress on the wheels is vastly greater, and this stress increases with the speed. This fact is overlooked by the automobile makers and drivers, who are apt to think that it is perfectly safe to turn a corner because it is easy. That lightness of construction is not inconsistent with strength and high speed is evident from a comparison of the present cars with those built two or three years ago. Much unnecessary material has been discarded, but the cutting-down process has been carried too far when applied to the wheels. Anything that impairs the stability in a direction parallel with the axis should be avoided.—*Abstracted from the Mechanical Engineer (London), July* 16.

The Electrical Situation in Italy.

In this review of the electrical situation in Italy, it is said that Italy has not been spared by the business depression in the electrical industry during the past four years. This depression reached the turning point some time in 1903, and since then conditions are better and continue to improve. This is true both of the importations and of the home manufactures and the improvement is more pronounced every month. Among the groups of foreign companies which have started branches in Italy with success are the Allegemeine Elektricitäts Gesellschaft, the Thomson-Houston Company, the Siemens-Schuckert Company and Brown, Boveri & Company. However, certain Italian houses have met this competition successfully, and now, in order to maintain a greater advantage against the foreign houses, have drawn together and have joined the Società Elettrica Italiana de Turin. The agreement allows a certain proportion of the profits to each of the companies. The total capital involved is about $1,750,000. Recently several Italian firms have joined to form a hydroelectric company with a capital of about $500,000, in order to develop and exploit certain water powers above the city of Spezzia. There is considerable power available here, and a storage lake will be formed, which will give a fall of water of about 470 metres (1,500 feet). The central station will be equipped with five alternators, each of 1,500 horse-power. —*Translated and abstracted from La Revue de l'Electricite (Lausanne), July* 15.

The Electrical Equipment of Overhead Traveling Cranes.

The method of wiring and controlling three-motor traveling cranes is described by Mr. J. W. Warr. For a fifty-ton continuous-current crane, the usual equipment is one twenty-horse-power motor, making 500 revolutions per minute, for shifting the crane; one eight-horse-power motor, making 750 revolutions per minute, for shifting the trolley, and a twenty-horse-power motor, making 500 revolutions per minute, for lifting. Occasionally there is a fourth motor employed for operating a supplementary hoist. All the motors should be enclosed, but arranged so as to make inspection easy. On an extension of the armature shaft of the hoisting machines the brake should be attached. This is usually a band brake operated by a spring, which is released by a solenoid in series with the motor. It is possible to cut out the solenoid when a heavy weight must be lowered slowly. By this arrangement the motor operates against the brake. This arrangement may be dispensed with in favor of a hand brake. For starting the motors, a liquid rheostat is advocated, consisting of a cast-iron tank partially filled with a solution of soda. The controller handle actuates by means of racks and a pinion and two plates in opposite directions. When the handle is in a vertical position both plates are up. Turning it one way or the other lowers one plate and raises the other. To reverse the direction of running, the handle is twisted through 180 degrees, which makes the proper change of connections on a switch attached to the top of the controller. The main crane conductors should be of strip copper, supported on insulated iron bolts. The conductors running along the crane are usually of bare wire, and rest upon hook-shaped collectors. Diagrams are given of the wiring of the crane, and a detailed sketch of the controller.—*Abstracted from the Electrical Review (London), July* 15.

High-Pressure Centrifugal Pumps.

A report upon the use of De Laval high-pressure centrifugal pumps, driven by means of the steam turbine, has been submitted by M. K. Sosnowski to the Société d'Encouragement pour l'Industrie Nationale, and is here given with an introduction by M. Léon Masson. These turbine pumps are driven at exceedingly high speeds. At these high speeds it was found necessary to supplement the high-pressure pump by an auxiliary pump driven at a lower speed, which would supply the former with water, as it was unable to draw up water rapidly enough. The efficiency of these pumps is fairly well maintained for a wide range of output and is about seventy per cent. They are suitable for raising water at great heights, for fire pumps, boiler feed pumps and mine drainage pumps. They have already been applied as feed pumps at Krokon, Sweden, where they are pumping water at a temperature of fifty degrees centigrade under a pressure of from eleven to twelve kilogrammes per square centimetre. This pump is driven by a twenty-five-horse-power electric motor. It operates very simply and requires but little attention. A pump of this type is also used in France, for draining out the Mines de Lens. It is driven by a steam turbine of 150 horse-power at 13,000 revolutions per minute. The auxiliary pump makes 650 turns per minute. This equipment raises 100 cubic litres of water per hour to a height of 260 metres. With equipment of this kind the auxiliary may

be used for other purposes, such as for circulating condensing water. The advantages claimed for this type of pump are: the high efficiency of the system—for, if the centrifugal pump is a little less efficient than a piston pump, the method of driving the former is much better; they are less cumbersome, are cheaper and require less attention; they operate without shock, thus avoiding the necessity of air chambers, and the starting torque required is small. The ease with which such pumps may be driven by electric motors is also of considerable importance.—*Translated and abstracted from the Bulletin de la Société d'Encouragement pour l'Industrie Nationale (Paris), June 30.*

Industrial Condensers.

In the process of producing nitrates electrically, which has been developed by M. Mosciki, it was found that the commercial condensers to be had were not satisfactory. He has made a study of all forms procurable, and not finding any sufficiently reliable, he has himself developed a type which seems to meet all requirements. The experimental work and construction of these transformers are described in this article by M. J. A. Montpelier. Tests made with condensers formed of glass plates and tinfoil showed that the dielectric loss was eight per cent. Mosciki then tried many other insulators, particularly ozocerite, but these materials were found not to have sufficient dielectric strength, and they were abandoned and attention turned again to glass. A type of condenser was then constructed and tested which consisted of a glass tube covered externally with tinfoil, and filled with mercury. These tubes were submerged in a bath of insulating material, and upon test, it was found that the losses had been decreased notably, and were not more than 1.5 per cent. Next, a condenser was constructed of ordinary glass plates, two millimetres in thickness, perfectly dry on one side, to which a thin sheet of tinfoil was cemented by means of resin, particular care being taken to avoid air bubbles and drops of resin. The plates thus prepared were heated for a considerable time in an electrical furnace at a temperature of 100 degrees centigrade, and then were taken from this furnace, and placed immediately in a bath of some insulated material, maintained hot by means of an electric heater. They were introduced vertically, and then allowed to sink slowly upon one side. In this way no bubbles of air were caught under the plates. Having assembled a sufficient number of plates in the bath, it was allowed to cool, and was then ready for use. Much trouble was met in obtaining a suitable insulating material—one which would adhere perfectly to the glass, and which would not contract with a fall of temperature. The best results were obtained with a mixture of ozocerite, resin and vaseline, in the proportions of one part, four parts and one part, respectively. Seventy-two condensers of this type were constructed, which were grouped together to form a battery with an apparent power of three kilovolt amperes. Each condenser was 9.5 millimetres high, with a surface of twenty-three by thirty-five centimetres, and weighed fifteen kilogrammes. It was composed of twenty-one plates of glass, each twenty by twenty-eight and one-half centimetres. The tinfoil sheets had a surface of sixteen and one-half by twenty-two and one-half centimetres. These condensers were able to support a tension of 50,000 volts for six hours. At the end of that time they became too hot for service. They could, however, support a pressure of 5,000 volts continuously. These condensers have been used for a long time without suffering any breakdown, and their loss amounts to three per cent. A return was then made to glass tubes, for several reasons—first, the tubes can easily be made thicker at the end of the conducting coating where the strain upon the dielectric is greatest; further, a type of condenser may be conconstructed which is easily cooled. The tubes used had a thickness of one-half millimetre, and were three centimetres in diameter. The thickness of the tube at the ends was from two to three millimetres. They were coated on the inside with silver, and were then placed in a cylindrical receiver through which water was circulated, the water forming the other surface of the condenser. A condenser of this type, having an apparent power of one-half kilovolt ampere, and which supports a pressure of 10,000 volts, is formed of five of these tubes, each forty-seven centimetres long. It weighs from three to three and one-half kilogrammes, and the loss is always less than one per cent at a frequency of fifty cycles per second. The volume of these condensers is less for a given apparent power than that of other systems. The one just mentioned has a capacity of 0.017 microfarad. They are inexpensive, and are suitable for general use.—*Translated and abstracted from L'Électricien (Paris), July 9 and 16.*

Thermal Storage.

A system of thermal storage, proposed some years ago by Mr. Druitt Halpin, has recently been tried by the engineer of the Kensington & Knightsbridge Electric Light Company, London, England, with reported excellent results.

In this system reservoirs of hot water under pressure are maintained as supplementary reserves to the ordinary boiler capacity. When a sudden and excessive demand for steam comes upon the boiler, the usual feed-water supply is shut off, and these supplementary reservoirs are called upon to supply the necessary water. At the Kensington & Knightsbridge Electric Light Company's station the question arose recently of increasing the output, and it was decided to try this method. The boilers are of the Babcock type, and evaporate 12,000 pounds of water per hour. The thermal storage vessel is on top of the boiler. The water here is heated to the full steam temperature. During times of light load this storage vessel is filled up, but when a peak comes in, the feed water is drawn from it by the regulating valve.

It is reported that when equipped in this way, the boilers evaporated two or three times as much water as they could deal with when fed from an economizer in the ordinary way. While this thermal storage system may have increased the capacity very considerably, it is hardly possible that the increase was as great as that stated, since in any case the heat required to evaporate the water must be supplied by the furnace, and all that is held in reserve is that which is stored in the water in order to bring it up to the temperature of the boiler; but the conditions of operation are doubtless improved.

Electrification of the Metropolitan Railway, of London.

The power station building for the Metropolitan Railway, London, in connection with the conversion of the line from steam to electric will be the most extensive in the United Kingdom owned by a single railway. The building covers an area of 3,570 square yards. Its equipment will be three large turbo polyphase alternators, each with a capacity of 3,500 kilowatts, equal to about 14,000 total horse-power and capable of supplying 17,000 horse-power during a stress.

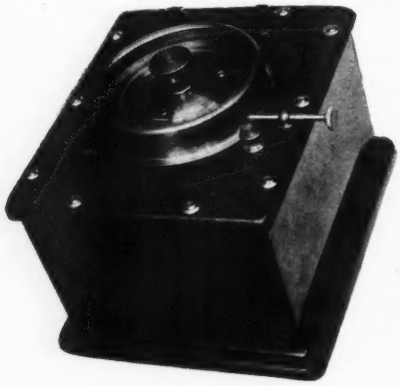
The three-phase alternators are to generate a pressure of 11,000 volts across each phase; at this pressure the current is transmitted by three-core armored cables to eight substations. The equipment is by the British Westinghouse Company.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

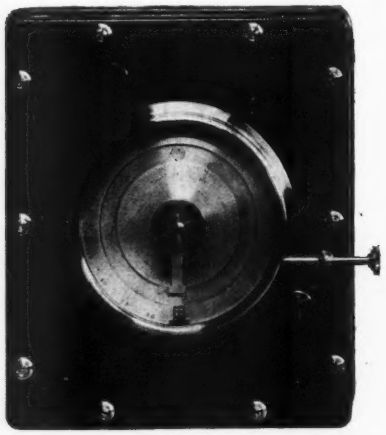
New Instruments of Precision.

In order to bring the standardization of electrical instruments to a place in keeping with its importance, the Westinghouse Electric and Manufacturing Company has developed a line of instruments of precision which combine the accuracy of the best-known standards with the portability and rapid and easy manipulation of the testing instruments now in vogue. The advantages of both types have been retained, with the elimination of those features which detract from their value in general use.



VOLTMETER.

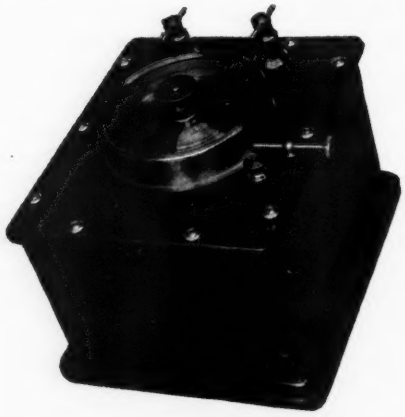
Having provided instruments of good quality, the Westinghouse Electric and Manufacturing Company proposes to secure to purchasers a continuation of their initial accuracy by keeping them in calibration for five years without charge. All the facilities of the Westinghouse department of standards are placed at the service of possessors of these instruments of precision so far as may be necessary to keep them accurate. Special shipping cases are provided to minimize the labor of packing and shipping. At any time within the period named customers may ship these instruments to the Westinghouse department of standards to be checked, and the work will be done promptly with no cost to the owners except that of carriage.



VOLTMETER DIAL.

By first providing instruments which fulfil perfectly the needs of the laboratory and testing room, and by then ensuring their continued accuracy, all the present trouble with checking standards is eliminated, and a new system for their care is inaugurated.

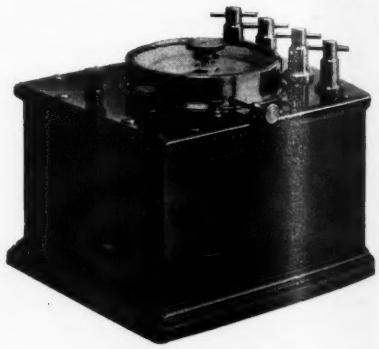
The illustrations show the voltmeter, ammeter, wattmeter and the resistance or multiplier used with voltmeter and wattmeter. The cases of the instruments are of polished mahogany, with all exposed parts finely finished. The mechanism is mounted in a cast frame made of a high resistance alloy, and suspended from the top plate. This is made of black enameled slate, giving a rigid construction and not affected by warping or changes in temperature. In principle, these instruments operate on the mutual attraction between two systems of movable and stationary coils arranged in inductive relation to each other, the two systems of coils being so arranged as to neutralize the mutual induction and the effect produced by any external field. The readings are thus equally accurate with direct and alternating currents and there is no necessity for reversing the readings on direct currents as with ordinary standards.



AMMETER.

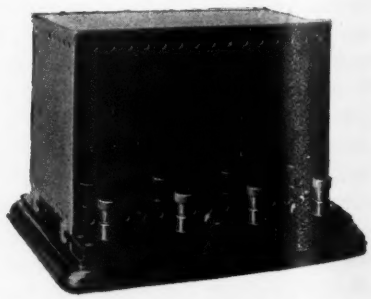
The controlling force is large, rendering negligible any friction effects, and presenting in this respect a strong contrast to the ordinary standards, in some of which the controlling force is so slight that the static attraction produced by rubbing the glass over the dial will introduce an error.

The voltmeter dial illustrated shows the general form used in the different instruments. The scale is accurately graduated upon a five-inch circle, all the divisions being uniform and thus equally legible over the entire range. By means of the vernier, tenths of a division may be read, giving a range of 2,000 readable divisions, greatly exceeding the readable range of any other standard instrument in general use.



WATTMETER.

The sight wire is shown in a square frame which is attached to the movable system. When current passes through the instrument, the sight wire is carried to the right of zero. By means of the large knob the vernier is turned to the left until the sight wire is approximately upon zero, a fine adjustment being obtained by the knob upon the right.



RESISTANCE FOR POTENTIAL CIRCUITS.

The two rubber-covered voltage terminals are also seen, with the stop for holding the movable element in a fixed position when the instrument is not in use.

The voltmeter and ammeter dials are similar. The inner graduations are so spaced that their value is proportional to

the square root of the deflection, allowing readings to be taken direct, without calculation. When readings of fractional parts of divisions are required, the outside scale with the vernier may be used and the corresponding value of the reading on the inner scale determined from the table of square roots furnished with each instrument. In the wattmeter there is but one set of graduations similar to those shown on the outer circle of the voltmeter scale.

The resistance or multiplier is used in the potential circuit of the voltmeter and wattmeter. The potential coils of the instruments are adjusted to a uniform resistance of 100 ohms, and the external resistance is subdivided so as to give total values of 1,000 ohms or multiples thereof. When in use a resistance of 1,000 ohms is employed for each 100 volts nominal potential. The resistances are accurately checked, and thus form standards as well as measuring instruments. As the same values are used for both voltmeter and wattmeter, one resistance will answer for both instruments.

The facilities afforded for accurate observation are worthy of special mention, and perhaps can be best appreciated by comparison with the instruments now in general use by comparing the fineness of the sight wire with the width of the pointer in the ordinary standard instruments; the narrow, even, machine-cut division lines of the scale with the hard-drawn irregular lines of other instruments; and the open divisions of uniform length giving equal legibility at all points, with other scales, the end divisions of which are little if any wider than the lines which divide them or the pointer that indicates the reading. This superiority, which is readily apparent, extends as well to other parts of the instruments, and to the design upon which they are constructed. They are in every way fitted for the checking of electrical metering devices and the accurate measurement of electrical quantities, while the free calibration ensures the perpetuation of their accuracy.

The *Four Track News* for August—the midsummer number—is just the sort of a publication that the vacationist delights to carry away and peruse at his leisure. The table of contents is too lengthy for reproduction, but it may be said that, in addition to the customary editorial matter, there is a large number of contributed articles by well-known writers, some of them illustrated. The *Four Track News* is published by Mr. George H. Daniels, 7 East Forty-second street, New York city.

A New Weatherproof Entrance Bushing.

The accompanying illustrations show a new weatherproof entrance bushing, and the method of applying this to an entrance pipe. Fig. 1 shows the "Boss" weatherproof entrance bushing; Fig. 2, the old method of weatherproofing, and Fig. 3 shows the method of weatherproofing an entrance pipe with the new "Boss" bushing.

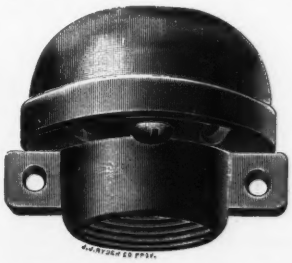


FIG. 1.—"BOSS" WEATHERPROOF ENTRANCE BUSHING.

In Fig. 2 the weatherproof bushing has the following parts: the universal couple, a return elbow, an outlet bushing, a pipe strap. With this method there are necessitated special fittings, and there is extra labor due to the difficulty of fishing the wires with the use of the elbow.

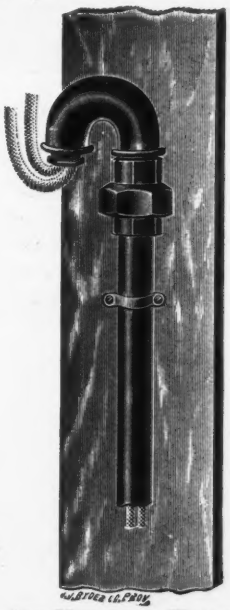


FIG. 2.—OLD METHOD OF WEATHERPROOF ENTRANCE BUSHING.

In Fig. 3 the weatherproof bushing has the following parts: bushing cap, bushing flange, circuit wires, connecting pipe, screw securing cap. With this method there is no fishing required where the wires enter the pipe. The cap is detached by simply loosening the screw. The bushing makes waterproof any wires that enter a pipe, and one of the principal uses to which it can be put is in connection with a transformer, where the house wires enter the conducting pipe. The device can be made to meet any special conditions that are called for, and is valuable for use in connection with fire-alarm boxes.

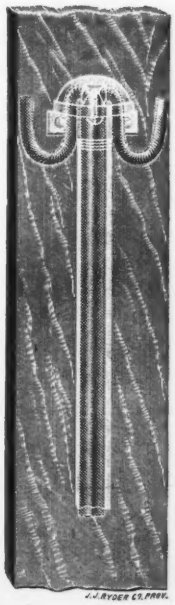
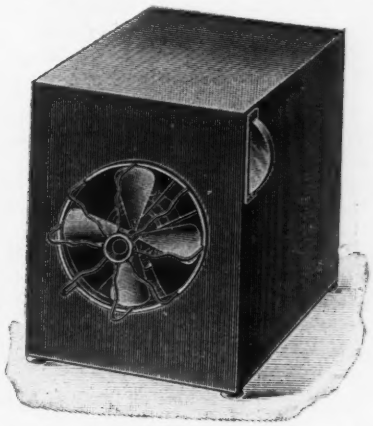


FIG. 3.—APPLICATION OF "BOSS" WEATHERPROOF ENTRANCE BUSHING.

This device is manufactured by the Belcher & Loomis Hardware Company, Providence, R. I.

An Electric Air Cooler.

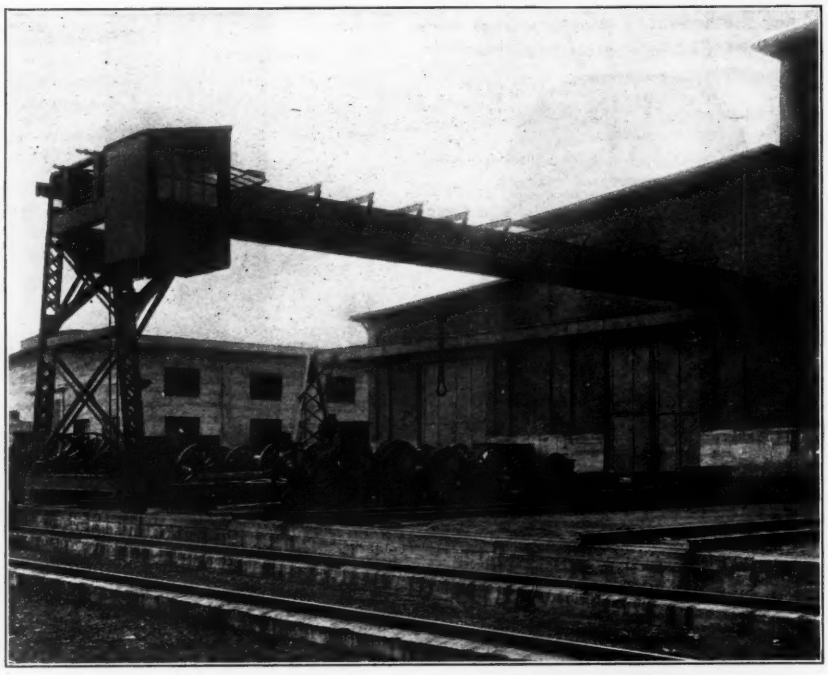
An electric air cooler, designed for hospitals, sick rooms, theatres and similar places is being placed on the market by the Improved Electric Glow Lamp Company, Great Newport street, London, W. C., England. As may be seen from the accompanying illustration, this cooler consists of a square cabinet open at both ends. At the front is fixed a twelve-inch porthole fan, which exhausts the air in the cabinet and creates an inward rush of air from the other end. Over this opening is provided a rolling screen or curtain of coarse net. This screen is revolved, by means of gearing from the fan spindle, through a trough of water, with the result that the air drawn in and out of the cabinet passes through a water screen and becomes moist and cool.



ELECTRIC AIR COOLER.

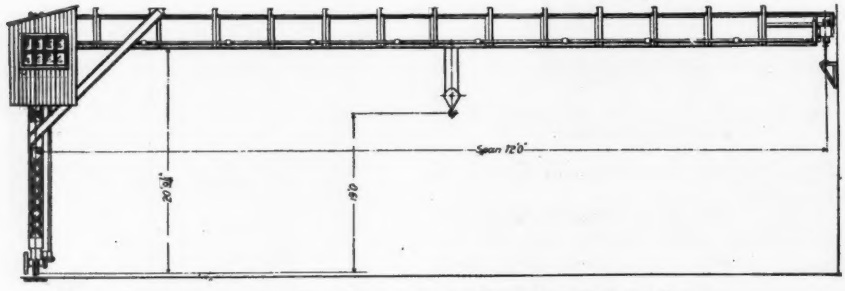
The Central Railroad of New Jersey Installs a Gantry Crane.

The Central Railroad of New Jersey has recently installed a six-ton, one-leg, Gantry crane at its Elizabethport shops. The crane has a span of seventy-two feet and is twenty feet nine and one-quarter inches in the clear. The present travel, which serves the machine shop only, is 112 feet, but an addition of 144 feet of track is contemplated, after which the blacksmith shop will also be served, and will make the crane available over an area of seventy-two feet by 256 feet.



SIX-TON, ONE-LEG GANTRY CRANE, ELECTRICALLY OPERATED.

The inner end of the crane is carried on brackets on the shop wall, while the outer rests on two legs having a sixteen-foot spread. The two girders are stiffened by latticing, and the saddle, secured to the lower flanges, is a track on which the trolley runs. The truck wheels are chilled iron fitted with bronze bushings. The bridge motor, placed on the long leg next to the cab, is geared to the vertical shafting, bringing an equal distribution of the gearing on each side of the motor and giving an even travel to both ends. Three independent closed type motors, made especially for crane service and designed to heavy overloads, control the hoist, trolley and bridge travel. The hoist motor is a seven-horse-power, 240-volt machine, running at 640 revolutions per minute and lifting at the rate of twenty-four feet per minute. Wire rope is used for carrying the load. The trolley drive motor is three-horse-power, 240-volt, running at 640 revolutions per minute. The crane travels at 100 feet per minute. The crane motor is a sixteen-horse-power, 240-volt machine, running at 750 revolutions per minute. The control is by three levers in the cab. A foot brake also controls the travel of the bridge. In addition there are automatic mechanical and electrical brakes. The trolley is protected from the weather by a roof.



DIMENSIONS OF SIX-TON ELECTRICALLY OPERATED GANTRY CRANE.

Maris Brothers, Philadelphia, Pa., are the builders.

Malleable Iron Pins for Mine Feeder System.

The Jeffrey Manufacturing Company, Columbus, Ohio, is marketing an insulating support for feed wires in mines. The pin is made in halves of malleable iron, threaded for a glass insulator at one end and barbed at the other, it is driven into position in the roof.

MALLEABLE IRON INSULATED PIN.

The insulator is cupped and the pin has a hollowed centre, allowing for drainage and preventing the collection of moisture on the feed wire.

A New Locomotive for the Jungfrau Railway.

A locomotive has recently been introduced on the Jungfrau Railway in which the electrical details, says the *Mechanical Engineering* (London), differ somewhat from the earlier types. It is equipped with two 150-horse-power, 450-volt to 600-volt, three-phase motors running at 760 revolutions per minute, and weighs 16.8 tons. A speed of five miles per hour is maintained on both the up and down trips. Special arrangements are provided for regulating the speed of the locomotive on the down grade. The motors work as synchronous motors on the up journey, but they can be connected up as self-exciting generators on the down run. The motors have three slip rings on the one side and a commutator on the other. The three brushes belonging to the latter are automatically lifted off the commutator by a three-phase magnet whenever the line circuit is connected up to the motors. A resistance capable of absorbing 170 kilowatts for a lengthy period is used both for starting and for braking.

Record-Breaking Track Work.

In the conversion of the Brixton and Streatham, London, cable road to the conduit electric system, probably as rapid work as any on record was done—18,000 feet of well laid double cable track were converted between April 6 and June 19, seventeen days ahead of the contract date.

The Engineering Company of America.

The Engineering Company of America is a corporation which has brought under one management the services of a number of engineers prominent in their respective fields, and whose work is so guided and systematized that any form of installation or equipment may be undertaken with assurance of success. In many instances, in the present day, industrial undertakings reach a sufficient magnitude to require the services of experts qualified in the many branches of engineering. The Engineering Company of America, by reason of its organization, is enabled to undertake work of this nature in its entirety. From the preparation of the preliminary plans to the turning over of the operating installation, the company carries out the work in detail. It becomes, in turn, the investigating engineer, the consulting engineer and the general contractor, in this way assuming the entire responsibility for every portion of the work.

In order to coordinate the various requirements of a large or small engineering operation, the company has drawn under one management specialists in every profession which may be interested in the work at hand. The labors of these specialists are so arranged that there is a dove-tailing of specifications and a means for a complete understanding of an entire installation, prior, even, to a preliminary report. After the specialists in the various branches have turned in their preliminary reports, the whole is examined and approved by a board of consulting engineers before being submitted to the client. The field of activity of the company covers the United States, Alaska, British Columbia, Canada, Mexico and South America. The company makes a specialty of the yearly management of plants and mines, and the supervision of installations requiring technical service.

Special facilities are possessed by the company for the investigation of plans for electrical engineering propositions, either steam or water power, from the survey to turning over the equipped power station. In electric railway work the company is also prepared to undertake problems of any magnitude.

In civil engineering, reports are made on existing and proposed railroads and other properties. Surveying, mapping and plotting are also taken up, estimates for contracts are given, and the construction of railroads undertaken.

In the field of mechanical engineering the company is prepared to make physical tests to determine the efficiency of machinery, to report on and present plans for structural work, simplification of mechanical details, examination and reequip-

IN THE OFFICE OF THE PRESIDENT AND GENERAL MANAGER, ENGINEERING COMPANY OF AMERICA.

WITH THE ENGINEERS, ENGINEERING COMPANY OF AMERICA.

ment of existing plants, and methods to be adopted to effect economies and increased efficiency.

Reports are made on existing and proposed electrical plants, plans are submitted, and supervision of contracts undertaken. The company also takes charge of the engineering and construction of installations, and has a department for the operation of railroad, light and power plants.

The company is also equipped to handle investigations as to hydraulic powers, presenting reports; undertakes the engineering features and construction work for city water supply, etc.

Under the head of chemistry, organic, inorganic, laboratory analysis and commercial and technical work are undertaken.

The company undertakes investigations and reports on smelting and metallurgical plants, the determination of the best methods of ore treatment, estimates, plans, and the construction and operation of metallurgical plants.

There is also a mining department, which reports on the precious, base and minor minerals, on mines and mineral lands, and investigates the occurrence, quantity and value of ore in mines.

The Engineering Company of America has its main offices at No. 74 Broadway, New York city. In addition to the quarters of the president and general manager, there is a large room devoted to the vice-president. The engineers under whose supervision the various reports are handled are placed in separate rooms, each man having his own departmental staff. There is a corp of experienced stenographers for report and general office work. The company has also provided an excellent reference library containing a great number of volumes of standard engineering works. This library is in charge of a specially appointed custodian, and is at the disposal of the clients of the company. The company has a well equipped draughting department in the same building, and this is in charge of engineers who have the special training in their several lines of work.

A Corner of the Draughting Room, Engineering Company of America.

Since the organization of the company it has been continually broadening, and in addition to a number of high-class properties which it is now developing, and a number of installations which mark it as successful in that direction, has under way the planning and construction of several important installations in various parts of the country.

The officers of the Engineering Company of America are: August Roesler, president and treasurer; Paul M. Mowrey, vice-president; C. W. Wheelock, general manager.

In addition to the main office in New York city, the company has branch offices at Chicago, Ill.; Denver, Col.; Charlotte, N. C.; Birmingham, Ala.; and representatives in various parts of the country.

The unusual size of the volume containing the proceedings of the Boston convention of the National Electric Light Association will necessitate making two separate books. One contains the "Question Box" and "Wrinkles," and the other the remainder of the papers, reports and discussions.

New Forms of Incandescent Lamp Receptacles.

The H. T. Paiste Company, Philadelphia, Pa., manufacturer of the "P-K" specialties, has recently added two new

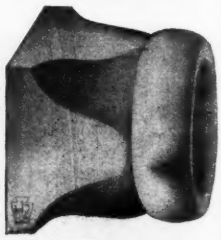


Fig. 1.—Show-Window Receptacle.

receptacles to its well-known line of Fielding receptacles. These are designated as show-window Fieldings, and are stated to be especially well adapted for display work.

These receptacles have smaller bases than the regular Fielding receptacles, the straight style—catalogue No. 33581—measuring one and one-half by one and one-half inches. Fig. 1 shows this receptacle. Catalogue No. 33582, the sixty-degree angle style, has a base two by

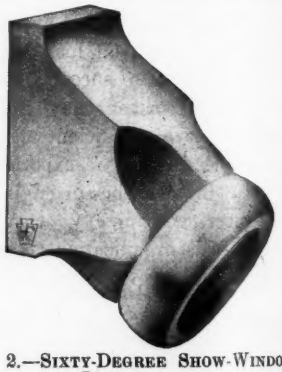


Fig. 2.—Sixty-Degree Show-Window Receptacle.

one and one-half inches. This permits wiring them much more closely together, thus obtaining stronger lighting effects. The angle style holds the lamp and reflector at an angle that throws all the light upon the articles making up the window display. The company has recently issued a new bulletin, No. 11, illustrating this line of apparatus, which it will be pleased to send upon request.

Electrical Ore-Finding Process Tested.

Recently the Daft & Williams electrical ore-finding process was described in a paper by Dr. Sylvanus P. Thompson. This was followed by an offer from certain mine owners in the Coniston district, near Barrow-in-Furness, England, to have the process tried at their mines. This has been done, and the mining company is now sinking shafts over the spots indicated by the new apparatus as probable position of continuations of the lodes of copper.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

POWER COMPANY TO UNDERTAKE LARGE MORTGAGE—The Niagara, Lockport & Ontario Power Company voted on July 25 to mortgage its corporate property for $24,000,000, to secure bonds for a like amount. It has filed with the secretary of state a certificate of incorporation to permit it to transmit electrical power as far east as Utica, and south to the Pennsylvania line.

CONTRACTS LET FOR THE BUILDING OF A NEW PENNSYLVANIA ELECTRIC RAILROAD—Contracts aggregating over $500,000 have been let by Pittsburg capitalists for the construction of an electric railroad from Garrett, Pa., to Frostburg, Md., a distance of twenty-five miles, by the Meyersdale & Salisbury Railroad Company. In addition to railroad operation, the company purposes furnishing light and power to a number of Pennsylvania towns, and will eventually operate a passenger line from Johnstown, Pa., to Cumberland, Md.

MORE CONNECTICUT ELECTRIC COMPANIES ABSORBED—The Westerly Railway and Lighting Company, of Westerly, R. I., which recently took over the Mystic Electric Light and Power Company, has completed arrangements for the absorption of other corporations. It has acquired the Pawcatuck Valley Street Railway Company, the South Shore Gas and Electric Company, and the Westerly & Hopkinton Railway Company. The Westerly Railway and Lighting Company now has a monopoly of the electric lighting business in Westerly, R. I., and in the Connecticut villages of Pawcatuck, Stonington, Mystic, West Mystic and Noank.

GENERAL ELECTRIC COMPANY MAY ADOPT WIRELESS TELEGRAPH SERVICE—It has been stated that the General Electric Company has been contemplating for some time the idea of installing the Fessenden wireless telegraph system between its Schenectady (N. Y.) and Lynn (Mass.) works. This arrangement would effect a material saving in time and money. The telegraphic and telephonic communication between these two points is almost constant during the busy hours, from 200 to 300 telegrams passing between them daily. It is expected that the system will be ready for operation early in the autumn.

LONG-DISTANCE ELECTRIC RAILWAY IN MEXICO—Efforts are being made to interest capital in a project for the construction of a line of electric railway between Guadalajara and Aguascalientes, Mexico. It is said that W. H. Wilkinson and E. T. Barnett, of Boston and Baltimore, respectively, and E. P. Shaw, of Massachusetts, are interested in the plan, and will supply a part of the necessary capital. The distance between the two Mexican cities is 130 miles. The building of an electric line between these two points, such as is contemplated by the promoters, would cut down the time of transporting passengers and freight from four to six hours.

NEW COMPANY FORMED TO SECURE CANAL TOWING EQUIPMENT CONTRACT—Papers of incorporation of the Central Power Manufacturing Company have been filed with the secretary of state at Albany, N. Y. The nominal capital is given as $10,000. The directors are Charles R. Huntley, William R. Huntley and D. T. Nash, of Buffalo. The company will operate in the counties of Schenectady, Saratoga, Albany and Rensselaer. The charter permits it to manufacture electrical apparatus and distribute power. The probability is that this company will make a strong bid to undertake the work of equipping the Erie canal with electrical towing apparatus, should this form of power be adopted.

IMPORTANT RIGHT OF WAY DECISION HANDED DOWN IN CHICAGO—Judge Grosscup, on July 27, 1904, ruled against the Chicago Traction Company's lawyers in the controversy over the formal decree of the United States Circuit Court in the ninety-nine-year cases. In an oral opinion he excluded from the protection and provisions of the act of 1865 the lines authorized by ordinances passed after May 3, 1875. On those lines authorized by ordinances passed prior to May 3, 1875, but which were not constructed until after that date, the Court expressed a desire to hear argument. This decision gives the city of Chicago absolute control of those streets which are now regarded as the key to the franchise controversy.

CONSOLIDATION OF MASSACHUSETTS TROLLEY ROADS—A plan is under way to reorganize the electric railways of southeastern Massachusetts. The important systems to be combined in this merger are the Middleboro, Wareham & Buzzard's Bay and the Bristol County roads. The former road runs from Middleboro Centre to Monument beach in the town of Bourne. It owns twenty-one miles of single track, and operates over about four miles of the track of the New Bedford & Onset Railway. It purchases its power from the New Bedford & Onset Company. The Bristol County Street Railway Company runs from Taunton to Attleboro. It owns about sixteen miles of single track and has its own power station. It is proposed to form a securities or holding company under the name of the Southeastern Electric Companies, on the plan of the Massachusetts Electric Companies.

EXTENSIONS OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY—The American Telephone and Telegraph Company is planning extensive additions to its long-distance telephone service. The company will build two lines into Meridian, Miss., work to be started at once. One of these will come from Birmingham southwest to Meridian, a distance of 150 miles; the second from Mobile, Ala., north to Meridian, about 140 miles. The long-distance lines of the Cumberland Telephone and Telegraph Company already connect with Meridian. The new lines will give direct communication with Chicago, St. Louis, Richmond, Atlanta and other cities. Two hundred men are employed in building the new lines. It is also announced that crews and right-of-way men and engineers are being sent over the principal parts of Cuba, to determine upon the feasibility of covering the island with long-distance lines.

AMERICAN EQUIPMENT FOR SOUTH AMERICAN RAILROAD RECONSTRUCTION—The American minister at Lapaz, Peru, writing to the state department, says that the Peruvian corporation owning and operating the Southern Railway of Peru, from Mollendo, on the Pacific, to Puno, on Lake Titicaca, and operating lake steamers in connection therewith between Puno and Guaquai, has acquired and taken possession of the Peruvian government railway from Guaquai to the city of Lapaz, for a term of seven years from June 1, 1904, under a lease. An extension of five miles will be made to the line, and this will be equipped electrically. It now seems possible that the Peruvian corporation will also be given a concession for the construction of a railway from Viacaha to Auroro, under a fifty-year lease. The length of the line will be 137 miles, and it is to be completed within three years after the final acceptance of the lease by the Peruvian corporation and the Bolivian government.

EASTERN COMPANY TO CONTROL INDIANA ELECTRICAL INTERESTS—Announcement has been made that the gas, electric lighting and traction companies of northern Indiana have been or will be taken over by a holding company controlled by Philadelphia capitalists. The gentlemen interested are said to be Randall Morgan, general solicitor for the United Gas Improvement Company, and J. Levering Jones, of the Investment Company of Philadelphia. Mr. Thomas B. Wanamaker is also said to have a large interest in the enterprise. The corporation will control all of the trolley roads entering Fort Wayne and Indianapolis, as well as all of the profit-earning roads in the suburbs of these cities. The gas and electric lighting concerns will be taken in under a general agreement, which provides for the economic management of these utilities from a common centre. The Indianapolis Traction and Terminal Company, the Union Traction Company, of Indiana, and the Fort Wayne & Wabash Valley Company are the largest concerns in the deal. It is expected that the several plants taken over will be thoroughly overhauled and several new power-houses erected.

ELECTRIC LIGHTING.

CAPE VINCENT, N. Y.—The Pentecost Lumber Company is about to begin the erection of a power-house.

EAST LANSDOWNE, PA.—It is stated that Philadelphia capitalists are presenting a project for the installation of steam heat and electric light plants in this territory.

FULTON, N. Y.—It is stated that the Fulton Light, Heat and Power Company has accepted a contract offered by the board of public works to furnish the city with lights at $75 each.

ROCKFORD, ILL.—At a meeting of the stockholders of the Central Heat and Power Company it was decided to spend $30,000 on additional electrical machinery, to be added before the fall.

LITTLE ROCK, ARK.—At a special meeting of the North Little Rock council an ordinance providing for the establishing of a waterworks and electric light system, to be owned and operated by the city, was adopted.

NEW ORLEANS, LA.—The Consumers' Electric Light and Power Company will, it is announced, shortly commence the work of erecting its plant. The company is backed by retail merchants of this city, all of whom are subscribers to the stock and will utilize the power developed.

FREDERICK, MD.—Extensive improvements are about to be made to the electric light plant of the Frederick Gas and Electric Company. The company has purchased two new dynamos, two engines, one of which is a 200-horse-power Corliss engine, a large amount of copper wire and other materials for reconstructing its lighting system.

COHOES, N. Y.—The annual meeting of the stockholders of the Mechanicsville Electric Light Company was held recently, when the following directors were elected: James Greenaway, M. F. Farron and Edwin Farron. The directors elected these officers: president and treasurer, Edwin Farron; vice-president, James Greenaway; secretary, M. F. Farron.

ALEXANDRIA, VA.—The council has accepted the proposition of Charles F. Thompson to light the city streets. He proposes to pay the city a bonus of $10,000; to take the present light works at $3,500; to furnish the city with thirty-nine or more arc lights for streets, etc., at $76 per annum each; to give bond that the work shall be begun within six months and completed within twelve months.

PERSONAL MENTION.

MR. ELMER P. MORRIS, who for many years has been identified with street railway and electric lighting matters, has recently returned from Mexico.

MR. J. R. CULLINANE, manager for many years of the Denison Light and Power Company, Denison, Tex., has assumed the management of the Texarkana Light and Power Company, at Texarkana.

A. C. HUMPHREYS, president of the Stevens Institute of Technology, was seriously injured by being thrown from his horse on July 22. He was dragged for some distance and his left arm broken.

MR. WILBUR B. DRIVER, president of the Driver-Harris Wire Company, who has recently been confined to his home through illness, expects to resume his position as selling representative in the near future.

PROFESSOR E. F. CHURCH, JR., of Lehigh University, has been elected to the head of the department of mechanical engineering of the University of Morgantown, W. Va., succeeding the late Professor Clyde Randolph.

DR. OTTO FEUERLEIN, director of the incandescent lamp department of the Siemens & Halske Company, of Berlin, Germany, is now in the United States on his way to the International Electrical Congress at St. Louis.

MR. W. F. WARDEN, president of the Burt Manufacturing Company, of Akron, Ohio, has returned from an extensive European trip. Mr. Warden found the market for his supplies very active, and reports a good business prospect.

MR. A. T. HOLBROOK, one of the oldest employés of the Nernst Lamp Company, and connected, until recently, with the district office at Pittsburg, has been appointed district sales manager of the Boston office, having supervision of the entire New England territory.

MR. JOSEPH A. MURRAY, Wilkesbarre, Pa., has been appointed general manager of the Fort Worth Telephone Company. Mr. Murray has assumed charge, and has announced that the connection with North Fort Worth, Tex., will be made shortly. The poles have been put up, and the wiring remains to be put in place.

MARCUS RUTHENBERG, who has been engaged at Lockport, N. Y., in experimenting with electrical methods for the manufacture of steel, is installing machinery for its production for commercial purposes at Niagara Falls. This is the first attempt, in America, to make use of electricity in steel manufacture, though it has been used abroad for some time.

MR. WILLIAM G. NORMAN has been appointed manager of the Dubuque (Iowa) Telephone Company. Mr. Norman was for many years chief despatcher for the Milwaukee railway system. He succeeds Mr. Victor Stevens as manager of the Dubuque company. The latter gentleman continues to hold the office of president of the company, although resigning his duties as manager.

MR. HUGH L. COOPER, formerly hydraulic engineer of the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, and now chief constructing engineer of the Mexican Light and Power Company, Limited, is on a visit to the United States. The Mexican Light and Power Company is building the Necaxa-Mexico City-El Oro power transmission system. The office of the company is at 29 Broadway, New York city.

MR. CHARLES M. SCHWAB, it is announced, will make a gift of $1,000,000 to Loretto, Pa., the town of his boyhood. He has informed the borough council of this, and a number of improvements will be undertaken if the gift is accepted. These will include the paving of the streets, the laying of sewer and water pipes, and the erection of a waterworks. An electric light plant for all purposes will also be erected.

PROFESSOR WILLIAM A. ANTHONY, chief of the department of physics of Cooper Union, New York, was painfully injured on Wednesday, July 27. Professor Anthony was riding a bicycle up Eighth avenue, New York city, when he collided with the pole of a wagon. He was taken to the J. Hood Wright Hospital, where he was found to have sustained a fracture of the hip and severe lacerations. Professor Anthony has long been known as an authority on electrical measurements, and has been called upon many times for expert testimony in court cases. He was president of the American Institute of Electrical Engineers in its earliest days.

CAPTAIN URQUHART, of the British ship Mohican, recounts a strange experience which overtook his vessel near the Delaware breakwater on July 30. The captain states that a cloud of phosphorescent appearance enveloped the vessel, magnetizing everything on board. The needle of the compass, he says, flew around like an electric fan, and when he ordered several of the crew to move some iron chains that were lying on the deck, these were found to be firmly held by some magnetic attraction. Bolts, spikes, bars and all other iron substances were in the same condition. For some time it appeared as if the ship were entirely enveloped in a glowing fire.

MR. WILLIAM B. BENTLEY, for a number of years superintendent of exchanges of the City & Suburban Telephone Company, Cincinnati, was the victim of an unfortunate error in the columns of the Cincinnati *Post* of July 27. In this item it was stated that Mr. Bentley was charged with furnishing information to the promoters of the Queen City Telephone Company. Upon investigation this was found to be absolutely without foundation. Mr. Bentley has had twenty years' experience in telephone work, and is a man of high standing in Cincinnati. The Cincinnati *Post* has published a retraction of this statement, regretting the error and announcing its pleasure at making the correction.

MR. J. H. HALLBERG, consulting and supervising electrical expert, 45 Broadway, New York city, has been retained as consulting engineer for the Atlantic Mills, Providence, R. I. Extensive electrical developments are now under way, and the mill already operates something like 1,000 arc lamps, about 1,000 incandescent lamps, and 700 horse-power in direct-current motors. There has now been

erected a new power plant, which will furnish power for a number of motors installed in one of the present mill buildings. Mr. Hallberg has been very successful at this plant in reducing operating expenses for the present equipment, and is now looking into the matter of a complete electric equipment, requiring an ultimate capacity of some 4,000 horse-power.

MR. WALTER C. McKINLOCK has been appointed district sales manager of the Philadelphia office of the Nernst Lamp Company, located at 1121 Walnut street. He will have supervision of this whole territory, consisting of eastern Pennsylvania, Maryland and the District of Columbia. Previous to his appointment Mr. McKinlock, for the past two years, was the successful representative of the Western Electric Company, Chicago and New York, for that territory comprising western Pennsylvania, West Virginia and Maryland, with sales offices in the Empire Building, Pittsburg, Pa. Among the central station managers, superintendents and purchasing agents Mr. McKinlock has many friends who no doubt will be glad to hear of his advancement and aid him materially to a large measure of success in his new position.

MR. DAVID E. EVANS has been elected president of the Maryland Telephone and Telegraph Company. Mr. Evans was formerly vice-president of the company, and succeeds Mr. George R. Webb, who resigned at the meeting of the board of directors, July 22, as president and director. Mr. Webb has announced that he retires to give more attention to his other large interests in the telephone and electrical field. These include the Pittsburg & Allegheny Telephone and Telegraph Company, and the Delmarvia Telephone Company, of Wilmington, Del. Mr. Webb contemplates a long trip in Europe, starting this week. Mr. Harry W. Webb was elected vice-president of the company, to succeed Mr. Evans. Mr. Harry W. Webb is a brother of Mr. George R. Webb, and in addition to being vice-president, is general manager of the company.

OBITUARY NOTICE.

MR. JOHN S. BAUMGARDNER, who for many years was connected with the Westinghouse Electric and Manufacturing Company, died last week at his home in Oakhill, Pa. Mr. Baumgardner was a veteran of the Civil War, and Major A. M. Harper Post, G. A. R., of Braddock, Pa., had charge of the funeral, which was held at Monongahela Cemetery.

ELECTRICAL SECURITIES.

Although during the past week there has been considerable fluctuation in prices, the closing day found things at substantially the same level as for the previous week. Following the announcement of considerable retrenchment by several large railroad corporations, prices fell off several points; but there was almost immediately a rally which brought values back to the normal. In spite of the cutting down, in a very material way, of service by the railroads above mentioned, the reports of earnings for the whole month of June and the first half of July are by no means as bad as were to be expected. Figures covering 75,000 miles of road show a decrease of only 2.8 per cent in earnings, compared with the same month of 1903. In May the same roads reported a loss of 5.4 per cent, and in April, 4.8 per cent. For the first three weeks of July the loss is 2.7 per cent.

There is also evidence at hand that better business is looked for in the steel industry. A favorable indication in this direction is the determination of the Homestead works in placing its large plant in full working condition; and there will also be a resumption of full time at the Joliet mills. One of the most important independent steel plants has decided to put over $1,000,000 into enlargements of its producing properties, which will add some 325,000 tons to the yearly production. It seems probable that there will be released very soon large orders which have been held in abeyance, awaiting some more favorable turn, from the buyer's viewpoint, in the steel market. It is also felt that in the iron trade there is a better condition coming, and that the near future will show a marked increase in orders.

Instead of improving, the general labor situation appears to grow worse. At the present writing the situation among the meat packers throughout the country is deplorable, and the gulf between the employers and the labor union is considerably widened. It is estimated that there are now some 26,000 labor men involved in the packing strike, and there have been added to this number 26,000 employés of the Fall River cotton districts. In western Pennsylvania the miners are showing a disposition to strike. In this direction, however, it is possible that the enormous surplus which the coal companies have piled up since the culmination of the strike of 1903 will influence the workmen to hold what they have in preference to a prolonged lockout.

Despite these adverse appearances, however, there is a strong feeling of confidence throughout the country. Manufacturers are looking forward to a busy season, and the weather conditions still favor a large crop output, both in cereals and in cotton. Therefore optimism prevails that the beginning of autumn will find industries in general on a much stronger and more prosperous basis.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 30.

New York:	*Closing.*
Brooklyn Rapid Transit	50⅝
Consolidated Gas	192¾
General Electric	160
Kings County Electric	197
Manhattan Elevated	150¼
Metropolitan Street Railway	117¾
New York & New Jersey Telephone	147
Westinghouse Manufacturing Company	175

It is announced that for the first seventeen days of July the earnings of the Brooklyn Rapid Transit Company amounted to $837,700, compared with $771,900 for the same period of 1903. The gross earnings for the fiscal year ended June 30, 1904, were $14,738,000, or an increase of $1,478,000 over the previous year. This represents a net gain equal to three and one-half per cent on the entire capital stock of the company. Out of the net income special appropriations amounting to $383,700 were made, and $1,500,201 was carried to profit and loss.

Boston:	*Closing.*
American Telephone and Telegraph	132
Edison Electric Illuminating	248
Massachusetts Electric	69½
New England Telephone	123
Western Telephone and Telegraph preferred	90½

Directors of the Boston Elevated Railway Company have declared a regular semi-annual dividend of 3 per cent, payable August 15.

The New England Telephone and Telegraph Company's directors have declared the regular quarterly dividend of 1½ per cent, payable August 15.

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	61
Electric Storage Battery preferred	61
Philadelphia Electric	6
Union Traction	53¾
United Gas Improvement	85

It is understood that the United Gas Improvement Company has agreed to accept for its holdings of West Chester Lighting Company common stock, aggregating between $6,000,000 and $7,000,000, 4 per cent general mortgage bonds at par, which will be issued by the new company to be formed, and guaranteed, principal and interest, by the Consolidated Gas Company. The preferred stock is exchanged for 5 per cent fifty-year debenture bonds.

Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	143
Metropolitan Elevated preferred	53
National Carbon common	29
National Carbon preferred	104
Union Traction common	4
Union Traction preferred	29

A statement of receipts and expenditures of the Chicago Union Traction Company from its formation, five years ago, to May 31, 1904, shows that in the last year the gross receipts were $1,100,000 more than in the first fiscal year. Operating expenses, however, have increased about twenty per cent. The books on June 30 show the following figures: 1900—gross earnings, $7,477,398; operating expenses, $3,761,797, leaving net earnings of $3,819,439. For 1904 (eleven months)—gross earnings, $7,815,360; operating expenses, $5,687,570; leaving net earnings of $2,252,010.

ELECTRIC RAILWAYS.

SAN FRANCISCO, CAL.—Alfred D. Bowen is at the head of a project to build an electric road from Healdsburg to Cloverdale.

FAIRCHILD, WIS.—Boston capitalists are figuring on an electric line from Eagle river to Merrill, thence to Rhinelander and other points.

CHESTER, PA.—The Media and Darby branch of the Media, Middletown, Aston & Chester Electric Railway Company has been placed in operation.

SAN ANTONIO, TEX.—The contract for the first twenty miles of a railroad from Cotulla to Carrizo has been let by the Rio Grande & Neuces Valley Railroad, and work will commence at once.

LEESBURG, VA.—Work on the extension of the Washington, Alexandria & Fairfax County Electric Railway to Fairfax Courthouse will be completed by November 1, when the road will be extended to Manassas and other points.

FORT WAYNE, IND.—The Fort Wayne, Van Wert & Lima Traction Company will begin construction on its road at once. The grading and bridge work have been completed, and the laying of the track and overhead construction will be pushed.

ASHTABULA, OHIO—A contract has been let for the construction of the first section of the Ashtabula & Lake Shore Electric Railway to connect Ashtabula Harbor and Woodland Beach Park, a resort on the shore a mile east. The intention of the company is to ultimately extend the line along the shore east and west.

RICHMOND, VA.—The Citizens' Rapid Transit Company, of which Mr. John C. Robertson is president, will soon begin the work of constructing its line, which will cover a large portion of this city and suburbs not already served. It is said that the company has ample capital with which to build and equip the new line, and that it will do both as soon as practicable.

NEW ORLEANS, LA.—W. H. Wood, of Centerville, Miss., and C. M. Sticker, of Fort Allen, are interested in a proposition to build an electric freight and passenger line to Centerville, and across the Illinois Central and the Mississippi Valley roads to the river bank. The road is to be built at a cost of $500,000, of which it is reported about two-thirds has been subscribed.

WATERVILLE, ME.—It is stated that work on the survey for the extension of the Somerset railroad is being pushed rapidly, and that several contractors have inspected the route preparatory to putting in bids for the work of construction. The extension will be from Bingham, at the forks of the Kennebec, to Birch Point, on Moosehead lake. It is expected that the laying of rails will begin in August.

HOLLISTER, CAL.—The Watsonville Transportation Company has completed arrangements for extending its electric railway from Watsonville to Hollister *via* San Juan valley. As soon as the survey is completed the work of construction will begin, and in six months the railway will be completed. Hollister will be the eastern terminus. The route will embrace the most fertile sections of Monterey and San Benito counties.

HARTFORD, CT.—The Windsor Locks Traction Company, which is building the connecting link of a continuous trolley line between Hartford and Springfield on the west side of the Connecticut river, has made arrangements with the Windsor Locks Bridge Company to carry its power cables across the river. Power will be supplied from the plant of the Hartford & Springfield Street Railway Company at Warehouse Point, on the east side of the river.

DOYLESTOWN, PA.—The promoters of the Pittsburg & Allegheny Valley Street Railway Company have asked for a franchise to enter New Kensington. The line will run through Vandergrift, Leechburg and Hyde Park, and if the franchise at New Kensington is given, a right of way will be asked in Parnassus and Arnold. From Parnassus the line will follow the Alleghany river and connect at Oakmont with the trolley line that runs to Pittsburg.

MOLINE, ILL.—Articles of incorporation have been filed of the Peoria & Rock Island Traction Company. The instrument states that the company is to construct a railroad from Peoria to Rock Island, the principal office to be established and maintained in Peoria. The company's stock is capitalized at $100,000, divided into 1,000 shares at $100 per share. The life of the corporation is fifty years. The incorporators are: W. B. McKinley, Charles Zill and B. R. Stevens, of Champaign, Ill., and B. F. Cartwright and J. E. Berry, of Peoria. Those forming the corporation are to compose the first board of directors.

NASHVILLE, TENN.—A survey is being made preparatory to building the Nashville & Columbia Electric Railway. The company which holds the franchise for building and operating this road and the Nashville & Gallatin Electric Railway intends to complete the former between Nashville and Franklin as soon as possible. H. M. Gross and T. J. Hawkins, of Pittsburg, and J. H. Connor, of this city, are the promoters, and state that ample capital has been secured.

UNIONTOWN, PA.—A new street railway project has been closed in which John R. Byrne, Charles H. Seaton, Frank M. Fuller and S. M. Graham are the local persons interested. They have associated with them capitalists from Philadelphia and New York and have secured control of the charters and franchises of four local companies covering the Brownsville and Bridgeport district and extending from Brownsville and Bridgeport to Uniontown and from West Brownsville to California. It is said the new company will commence work on the new line from Brownsville to Uniontown at once, and will have it completed within a year or two. The old companies will all be merged into a new one.

COUNCIL BLUFFS, IOWA—The annual meeting of the board of directors of the Council Bluffs, Tabor & Southern Electric Railway Company, in Tabor, resulted in the election of the following officers: president, W. J. Dobbs, Tabor; vice-president, R. J. Mawhor, Tabor; secretary, A. G. West, Tabor; treasurer, E. M. Sanger, Boston, Mass. Mr. Sanger succeeds H. C. Dye as treasurer, Messrs. Dobbs and West being reelected. The directory consists of the following: W. R. Goy, A. G. West, R. J. Mawhor, W. H. Rhode, W. J. Dobbs, Tabor; E. M. Sanger, Boston; George F. Wright, Council Bluffs. The most important business of the meeting was the transferring of the execution stock of the Electric Promotion Company to the railway company, the latter now assuming all the liabilities. This action, which was taken some time ago, was ratified at the stockholders' meeting. About $25,000 has now been expended in the surveys, securing right of way, franchise and other preliminary necessities. It is estimated that $15,000 will have to be spent yet before construction begins.

DES MOINES, IOWA—H. H. Polk, president of the Interurban Railway, states that the company contemplates the construction of a thirty-five-mile line of electric road either to Adel or Dallas Center, where connection will be made with the newly financed Western Iowa Electric coming east from Omaha. The line may be built this summer. In addition to the construction of the Adel or Dallas line, one of which may reach Perry, there is also a probability that a new line north from the city will be constructed for the purpose of assisting the commercial enterprises located in that district. The officers of the interurban have for some time had a contract with the Western Iowa line to the effect that a connection should be made at a point west of Des Moines. This will afford the necessary entrance to Des Moines and one by the local interurban into Council Bluffs. In a short time a contract will be let for the construction of a steel bridge across the Des Moines river for the use of the interurban exclusively. This will afford an entrance to the territory occupied by the coal mines and brick plants on the south side of the river.

CHESTER, PA.—An application has been made at the state department at Harrisburg for a charter for a proposed electric railway corporation which, if built, will be an important factor in local transportation facilities. The new corporation is to be known as the Philadelphia Terminal Railway Company, and its route, as filed, includes twenty-eight miles of electric lines, one stem leading from the terminus of the Philadelphia Rapid Transit Company's new elevated structure, at Sixty-third and Market streets, Philadelphia, to Eddystone, where connection will be made with the Chester city railways systems, and direct communication established with Chester and Wilmington. The other stem will extend from Sixty-third and Market streets, in a general course paralleling the main line of the Pennsylvania Railroad, to Malvern, Chester County, tapping the populous suburban sections in Upper Darby, Haverford and Radnor townships. The incorporators are Clarence Wolf, president; directors, Benjamin Wolf, Edwin Wolf, Samuel A. Boyle, Jr., Frank A. Barnett, William R. Benson and A. J. Jeffris. Mr. Clarence Wolf is the principal projector. The new company is capitalized at $10,000 a mile, or $280,000.

TELEPHONE AND TELEGRAPH.

BANGOR, ME.—The Farmers' Telephone Company is installing an exchange at Blaine.

LADYSMITH, BRITISH COLUMBIA—A telephone system is to be installed in this town.

DEADWOOD, S. D.—The Nebraska Telephone Company has installed a new $25,000 plant.

ORISKANY FALLS, N. Y.—The Madison Mutual Telephone Company has opened its exchange in this place.

CLARKSVILLE, TEX.—The Independent Telephone Company has begun work on its exchange in this city.

JACKSONVILLE, FLA.—The city council has granted a franchise to the Postal Telegraph-Cable Company.

ALBION, N. Y.—The Bell Telephone Company has installed a new switchboard accommodating six operators.

SWANSEA, MASS.—The Southern Massachusetts Telephone Company has erected a line from South Swansea to Touisset.

PROVIDENCE, R. I.—The Providence Telephone Company has awarded a contract for a new telephone building at Riverpoint.

ADAIR, IOWA—The Grant & Audubon Township Mutual Telephone Company has been incorporated with $3,000 capital stock.

DALTON, GA.—The Dalton Telephone Company has begun the erection of a telephone line to a point six miles north of Dalton.

LOS ANGELES, CAL.—The Home Telephone Company will, it is stated, extend its line to San Francisco, at an expense of $1,000,000.

BROOKLYN, N. Y.—The New York & New Jersey Telephone Company is laying a conduit in Rockville Centre with a capacity of 1,600 wires.

JOHNSONVILLE, N. Y.—The Farmers'-Telephone Company has been formed by Ira Haner, Ernest Abbott, James Marshall, Hiram Sherman and others.

NORTHFIELD, MINN.—At a meeting of the common council the Tri-State Telephone and Telegraph Company was granted permission to run its line into this city.

MONTREAL, CANADA—The Canadian Telephone Company has elected the following officers: president, G. G. Hurd; vice-president, A. Adam; secretary-treasurer, A. G. Hurd.

LINCOLN, NEB.—The Cedar Mutual Telephone Company, of Oakdale, with an authorized capital stock of $5,000, has filed articles of incorporation in the office of the secretary of state.

BURBANK, CAL.—The Home Telephone Company is installing a line from this city to Toluca and also one to Hollywood, and connection will be made with Tropico and Glenwood shortly.

EAST AURORA, N. Y.—The Haines Telephone Company has sold out its plant and holdings to the Interocean company, which will spend considerable money in perfecting and extending the system.

LYNNVILLE, TENN.—A new line is being built east of this place by the Cumberland Telephone Company. The company also contemplates making substantial improvements and additions to its local exchange.

SOUTH ROYALTON, VT.—The Rapid Telephone Company has constructed an additional line from South Royalton to Rochester, and will put in a line from Barnard to connect with that near Royalton.

SOUTH NORWALK, CT.—The Southern New England Telephone Company is at work installing exchanges in Woodbury, Newtown, Watertown and Stafford Springs, and later in the summer will put in one at Glastonbury.

CONWAY, S. C.—A telephone company has been organized for the purpose of installing a telephone exchange in this city. Robert B. Scarborough is president; H. P. Little, vice-president, and C. E. St. Armand, secretary.

MANITOWOC, WIS.—The Manitowoc Telephone and Telegraph Company, in which H. C. Dodge, of Chicago, is interested, has applied to the council for a franchise covering the city. It guarantees to extend its system into the surrounding territory if given favorable action.

FAIRFIELD, ME.—The Farmers' Cooperative Telephone Company has installed a line connecting Fairfield Center with Norridgewock. Other lines connecting with Fairfield and East Fairfield will be built within a short time.

TUCSON, ARIZ.—The Consolidated Telephone, Telegraph and Electric Company has been organized to operate the local Bell and Sunset telephone interests. It is the aim of the company to extend the lines to all parts of Arizona.

MAYSVILLE, KY.—The Flemingsburg Telephone Company has begun work on a line to Carlisle. This line will pass through Elizaville, Ewing, Cowan and Pleasant Valley, affording direct connection with all points in central Kentucky.

DETROIT, MICH.—A new telephone line is being erected between Carleton and Stoney Creek by the People's Telephone Company, of Wayne and Monroe counties. A new line has also been added to the main branch running out of Flat Rock.

MERIDIAN, MISS.—It is stated that the American Bell Telephone Company is inspecting the territory between Meridian and Livingstone, with a view to installing a telephone system. The company is now at work on a line from Birmingham to Livingstone.

NIAGARA FALLS, N. Y.—At the annual meeting of the Home Telephone Company, held recently at Niagara Falls, it was decided to expend between $35,000 and $40,000 in improving the local service. A new exchange is to be erected on the company's property on Cedar avenue.

SALINA, KAN.—The Salina Telephone Company has become the owner of the Lindsborg and Marquette exchanges, together with connecting toll lines in McPherson, Ellsworth, Rice, Barton and Saline counties. The capital stock has been increased from $50,000 to $100,000, and many extensions and improvements are to be made.

DETROIT, MICH.—It is stated that the subscribers of the Michigan State Telephone Company have increased from 45,000 to 60,000 since its formation. The company has 40,000 miles of copper wire strung in the state, and expects to add 4,000 miles before winter sets in. About 1,000,000 pounds of copper wire will be used in the construction.

LARAMIE, WYO.—The Postal Telegraph-Cable Company will start work August 10 on its line from Laramie west. The company, which is already established at Cheyenne, will use the poles of the Rocky Mountain Bell Telephone Company for its wires from that city to Laramie, but from here west will erect its own poles upon the Union Pacific right of way.

RUSSELLVILLE, ALA.—The Russellville Telegraph Company, a local organization, has sold out the Russellville exchange and the line from Russellville to Tuscumbia to the Southern Bell Telephone Company. The new purchaser, it is understood, will at once install a long-distance service and will extend the line to Jasper, giving direct communication with Birmingham.

SCRANTON, PA.—It is announced that the Consolidated Telephone Company will expend about $100,000 in improvements in the vicinity of Reading. The lines will be extended to West Reading, Northeast Reading, Mount Penn, Birdsboro and Lebanon. At Birdsboro connection will be made with a new line which is now being built from Lancaster through the Conestoga valley.

SPRINGFIELD, OHIO—The following officers have been elected by the Miami Valley Telephone Association: president, A. F. Broomhall, Troy; vice-president, W. H. Kessler, of West Milton; secretary and treasurer, W. D. Rush, of Greenville; executive committee, I. H. Theideck, Sidney; L. E. Simes, of Covington; L. M. Flesh, of Piqua; A. F. Broomhall, of Troy; W. H. Kessler and W. D. Rush.

CANASERAGA, N. Y.—A new telephone line will shortly be erected from Arkport to this place, connecting at the former place with the Interocean line, and at Canaseraga with the new line from Dalton and Nunda. The officers of the company are as follows: president, Jacob Schwingle; vice-president, Albert Schmill; secretary, Frank Wilkins; treasurer, Gibbon Manley; directors, Lyman D. Wilkins, James Gardner, George Wallace and Oscar L. Height.

INDUSTRIAL ITEMS.

THE GARVIN MACHINE COMPANY, New York, Philadelphia and Syracuse, has issued a new booklet, list No. 30, of second-hand machine tools.

THE CRESCENT COMPANY, Chicago, Ill., describes in bulletin No. 230 a lamp coloring and frosting fluid, the newest addition to its line of Crescent specialties.

THE CLIFTON MANUFACTURING COMPANY, Boston, Mass., announces that it will remove, on August 1, to 65 Brookside avenue, Boston, Jamaica Plain district.

THE NATIONAL WIRE CORPORATION, New Haven, Ct., moved its general and executive offices, on August 1, from New Haven to the Engineering Building, 114 Liberty street, New York city.

THE FEDERAL ELECTRIC COMPANY, Chicago, Ill., announces the removal of its offices and factory to Girard, Pa., where increased shop equipment will facilitate the handling of orders. Inspection of the new plant is invited.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has printed a new price list of the Jeffrey water elevators. These water elevators may be adapted to various forms of driving. The price list, which is No. 6213, will be mailed upon request.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., is distributing an attractive souvenir, containing numerous half-tone reproductions of scenes about Providence. In addition, there are illustrated some of the various specialties manufactured by the company.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., it is announced, has secured a contract for the installation of a telephone exchange system in St. Petersburg, Russia, capable of accommodating 40,000 subscribers. The work of laying conduits for this system has been going on for some time.

THE WYCKOFF PIPE AND CREOSOTING COMPANY, Stamford, Ct., has been awarded the contract, by the city of Baltimore, Md., for furnishing the creosoted wooden paving blocks to be used for paving bridges in that city. This was awarded the company after a series of experiments with various paving materials at a bridge approach subjected to heavy traffic.

THE REED MORRILL ELECTRIC COMPANY, Philadelphia, Pa., under the caption, "Something New Under the Sun," publishes an attractive little booklet setting forth the advantages of speed jacks. Besides the descriptions, nine pages of data entitled "Ratio of Transformation" give the sizes and types of jacks to be used to the greatest advantage, depending upon the working conditions.

W. S. HADAWAY, JR., engineer, 136 Liberty street, New York, having made a study of electric heating problems, is giving his patrons the benefit of this experience. His apparatus is all made for the specific use for which it is intended, thus possessing the distinct advantage of fitting existing conditions. A circular published by Mr. Hadaway gives some of the results of his observations.

THE F. D. LAWRENCE ELECTRIC COMPANY, Cincinnati, Ohio, is the new name of the Lawrence-Hall Electric Company. The establishment has recently been enlarged, and the warehouse and storerooms now run through the entire block from street to street. A large stock of electrical supplies of every description is carried. Mr. F. D. Lawrence, the well-known electrical supply man, is now president of the company.

THE ELECTRICAL APPLIANCE COMPANY, Cincinnati, Ohio, is meeting with success in the adaptation of the Churcher alternating-current rectifier, of which it is the manufacturer. Automobile storage batteries may be charged from an alternating-current source. The company states that the apparatus is cheaper to install and has a greater efficiency than a motor-generator. Descriptive bulletins will be sent on request.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, in a new catalogue, describes its Sunburst Prismo lamps. These lamps are found to be very satisfactory, especially where a lamp between the arc and incandescent is required. The lamp is made with the prism glass reflector or the metal reflector and collar. Catalogues may be had from either the manufacturer or the Western Electric Company, New York and Chicago.

MR. CHARLES F. JOHNSON, 802 Ellicott Square, Buffalo, N. Y., has for sale a large line of miscellaneous electrical apparatus, including dynamos and motors, open and enclosed cars, engines for both belt and direct connection, rails, trolleys and auxiliaries, and power station equipment. Mr. Johnson will be pleased to send a list of items which are ready for immediate shipment, or will be pleased to bid on any items which may be required.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in bulletin No. 84 describes the installation of chloride accumulators in residential lighting and power plants. A number of fine half-tone illustrations show residences and typical plants. The handsome residence of Mr. P. A. B. Widener, at Elkins Park, Pa., and the switchboard and battery-room are shown. There are also illustrations of the residences and battery plants of Mr. W. L. Elkins, at Elkins Park, Pa.; Mr. A. G. Vanderbilt, at Newport, R. I.; Mr. C. F. Hoffman, Newport, R. I., and the battery-room in the power-house of Mr. Edgar T. Scott, Lansdowne, Pa.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is enjoying a large foreign demand for its generators and motors. The company calls attention to the following letter, which was recently received from a Japanese electrical engineer: "Tokio, Japan. Messrs. Crocker-Wheeler Company, Ampere, N. J., U. S. A. Gentlemen: I beg you please to send me a copy of your precious catalogue, which I have great a interest, as I shall commence some trifling business for the electrical engineer in after a few months. If you favor it for me I should be in great thankfulness."

JOSEPH H. THOMPSON, JR., room 619, Bowling Green Building, New York city, publishes monthly a bargain list of electrical and steam machinery. This list always contains a miscellaneous assortment of apparatus which has had prior use, but which, while not absolutely new, is all guaranteed by the dealer to be in first-class condition. Joseph H. Thompson, Jr., is the New York representative of the H. P. Cameron Electric Manufacturing Company, making a specialty of commutators, and he is also the New York representative of the Missouri-American Electric Company, for whom he will quote prices on incandescent lamps.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., has prepared an elaborate souvenir describing the social features of the company. This souvenir has been prepared for the Louisiana Purchase Exposition, at the request of the Bureau of Statistics of Labor and Industries of the state of New Jersey. The book takes up in detail the formation of the Weston Employés Club. This club has been of great benefit to the Weston employés, and a spirit of harmony exists which is rarely approached in manufacturing institutions. In addition to the material concerning the Weston Employés Club, there are given several views and a description of the works of the Weston Electrical Instrument Company, at Waverly Park, Newark, N. J.

GUNN, RICHARDS & COMPANY, 41 Wall street, New York city, one of the most enterprising and successful engineering corporations, have removed to new and greatly enlarged offices at the above address. Gunn, Richards & Company are known as production engineers, and are retained not only for engineering and construction problems by a growing number of large industrial corporations, but make a specialty of systematizing accounts, financing new installations, and in every way giving practical and professional assistance in the development of properties of any magnitude. By reason of the facilities which this company possesses in the services of engineers of high standing in all of the engineering branches, it is able to bring the cost of production to a minimum, and, at the same time, greatly enhance the value of existing installations. The company has been more than ordinarily successful in laying bare the weak points of organization after investigation. This matter of investigating the production end of existing corporations is now considered a serious part of the business economy, and it is in this line that Gunn, Richards & Company are meeting with most pronounced success.